

IMPAX Orthopaedic
Application User's Guide
Using the Orthopaedic Application



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11/21/05

Revision Record

Document Name: IMPAX Orthopaedic Application User's Guide

Revision date	Description
January 2004	Initial version
January 2005	Updated copyright, title, reference on page 7.
November 2005	Updated copyright date on page 2, updated installation guide title on page 8.

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Welcome

The Orthopaedic Application provides you with a high-performance tool for the precise planning of hip implants. The Orthopaedic Application enables you to work without film at traumatological, orthopedic, and pediatric workstations.

Modules

The Orthopaedic Application supports you with the following modules:

- Hip Endoprosthetics for the systematic selection of prostheses and for planning hip implants to ensure an exact fit
- Hip Biomechanics (Biometry) for biometrically perfect preparation of implantation
- Coxometry for precise measurement of clinically relevant hip data for children's and adults' hips
- Knee Endoprosthetics for optimum planning of operations with the aid of both partial images and images of the whole leg in a standing position
- Osteotomy I for optimum planning of preoperative axis situation and simulation for single and multiple osteotomies
- **Optional:**
Osteotomy II for calculation and correction of complex deformities of the lower limb as Dror Paley. This module is delivered with a separate user manual.

Advantages

The Orthopaedic Application offers the following advantages over other methods of planning prostheses:

- Digital planning images and scan data are transferred from and sent back to the DICOM image database, optimizing your workflow.
- Preoperative biometric measurements can be taken with the greatest precision with just a few clicks of the mouse.
A high standard of quality is ensured in preoperative diagnostics and treatment planning.
- All of the manufacturers' templates that you need can be chosen selectively from a prostheses database. Prostheses can be adapted to the anatomical situation with the greatest precision. This helps to avoid in advance the danger of malpositioning, which can lead to premature loosening of the prosthesis.
- The Orthopaedic Application handling is improved because it is user guided.
- The time involved to get a perfect planning is little. Several functions have been optimized. Many single steps are now integrated into only one step.
- Working with the Orthopaedic Application is similar to usual MS/Windows programs.
- The user interface can be translated into nearly all languages.
- The Orthopaedic Application can be used within the daily clinical workflow as well as for scientific studies.

You see just how quickly you can carry out the best possible planning with the Orthopaedic Application.

Documentation

You can save the planning data as digital DICOM images in the database on your workstation and transfer these to a central DICOM archive. As a result, you can retrieve the planning data quickly whenever this may be necessary, for example, for a follow-up or for a demonstration in a patient consultation.

You can also print out the plans on a printer.

All relevant legal requirements are met when you use the Orthopaedic Application (in Germany: SGBV5§136/137 ff.).

System description

The Orthopaedic Application planning software can be installed on your PACS System. Take into account the hardware requirements for these systems.

Intended use

The Orthopaedic Application is designed to help in the planning of surgical procedures in the field of orthopedics and allows proper assessments to be made of geometrical changes in the lower extremities and therapeutic conclusions to be drawn. After the entry of correct patient data, the Orthopaedic Application provides the physician with additional information to be used in diagnosis, which was previously unavailable from the X-ray images.

The Orthopaedic Application enables the user to relate various procedures commonly used in medicine to precise measurements, thereby minimizing or ruling out previous risks in diagnostics.

The Orthopaedic Application allows precise digital planning and documentation of prosthesis implants and osteotomies on knee and hip joints.

Installing the Orthopaedic Application

Information about the installation of the Orthopaedic Application is described in the *IMPAX 6.0 Client Installation Guide*.

Legal information

The operating and application software used in this product is protected by copyright. The software may only be used if it has been released by Hectec GmbH. Hectec GmbH reserves the right to make changes to the design, and therefore the technical data, without prior notice.

Data protection

Data relating to individual persons is subject to data protection. Ensure compliance with all applicable laws and regulations in your country.

Documentation

Orthopaedic Application

The Orthopaedic Application User's Guide, which you are currently reading, contains detailed information on how the Orthopaedic Application works and what functions it offers. You will find out how to operate the Orthopaedic Application and how to use it effectively. It also gives you many practical notes and illustrations help to clarify the working procedures.

Conventions

- L:** ● To do the indicated step, click the left mouse button.
- R:** ● To do the indicated step, click the right mouse button.
- M:** ● Drawing mode is preset but can be changed if necessary or required.

Warnings and safety information

To use the Orthopaedic Application safely, you must read the User's Guide carefully. We assume that the Orthopaedic Application is only used by expert personnel.

Warnings and notes are specially highlighted in the documentation.

NOTE:

This highlights information on how to make best use of the equipment and the software, and additional useful information.

CAUTION: This highlights circumstances or consequences that you should pay particular attention when working with the Orthopaedic Application.

WARNING:

This draws your attention to situations or circumstances that can have serious consequences for the patient.

Basics

In Basics you will find an introduction to the general procedures used when working with the Orthopaedic Application as well as detailed descriptions of the most important basic functions, for example loading images, scaling, and image requirements.

For information about the user interface, refer to ***Working with the Orthopaedic Application***.

Import of images

Original images

To plan prostheses with the Orthopaedic Application, you can use digital images of different origins and from various sources. Suitable images for planning with the Orthopaedic Application are:

- DLR images (digital luminescence radiology)
- SSD images (solid-state detectors)
- Fluoroscopic images

DICOM images can be loaded from:

- Your database
- Other computers
- The archive
- CD

You can import images in various formats into your PACS System database:

- JPEG
- BMP
- TIFF

In addition, you can scan in (digitize) film sheets by connecting your system to a scanner.

Preparing planning

Hipendoprosthesis/Biometry

The basic requirements for planning a surgical procedure are x-rays taken according to the following criteria:

- Symmetrical positioning of the pelvis
- Hip joints in neutral position
- Longitudinal axis of the femur parallel to the image receptor plane
- Patella in zero position
- Central ray beam on femoral head center or symphysis
- Lead sphere of known size or scale bar at the level of the femur shaft as a calibration aid

NOTE: When taking the x-ray, avoid oblique positioning, abduction, or external rotation of the legs; otherwise, the optimum rotation center of the endoprosthesis cannot be determined accurately.

Biometry

Caution: In addition to a sufficient femoral length, the iliac crest must be shown to define exactly the 10 biometric points.

Coxometry

To obtain reliable angle dimensioning, the following techniques regarding positioning of the patient and focusing of the equipment must be taken into account when taking the image:

- Symmetrical positioning of the pelvis
- Central ray beam focused on dominant image area
- Longitudinal axis of the object parallel to the image receptor plane

Note:

To determine the degree of development of the acetabulum (for example, AC-HILG, ACE), the pelvis must not be in a lordotic position (flexion of hip and knee joints) and the patella must be in the zero position.

To determine the situation of the femur head, femoral neck, and femur (for example, CCD angle), the patient must be positioned in such a way that the longitudinal axis of the femur is parallel to the image receptor plane. The hip joints must be in a neutral position and the patella in the zero position.

Knee Endoprosthetics

Either images showing part of the leg or x-rays in a standing position showing the whole leg in an A-P (anterior-posterior) ray path are suitable for prosthesis planning with the Knee Endoprosthetics module.

A number of images showing part of the leg can be combined to produce an image showing the whole leg in the standing position.

Note:

Axial misalignment can only be correctly calculated if the image used for planning fulfills the following requirements:

- A-P image showing one leg only (taken of both legs) or showing both legs in a standing position with equal weight on the legs
- Hip joint and ankle joint visible in full
- For calibration purposes, a lead scale (at the level of the longitudinal axis of the femur) must be shown on the image

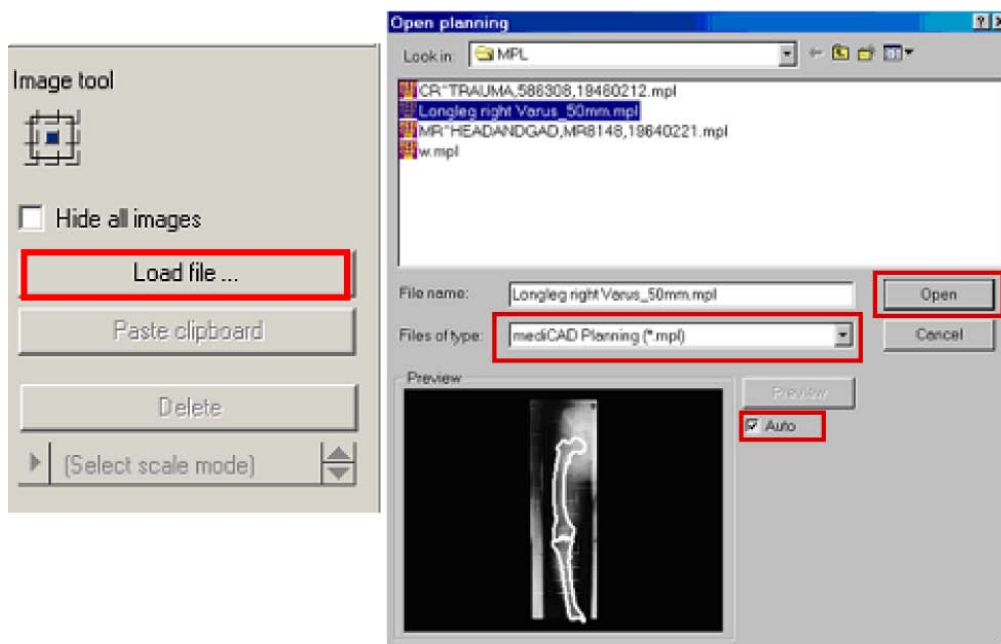
Importing a DICOM image

To import DICOM images into the Orthopaedic Application:

1. Start the Orthopaedic Application.
2. On the vertical toolbar, click on the icon **Insert images**.



- The **Image Tool** appears, click on **Load File**.
3. Select the drive and the directory where the image is stored.
 4. Select the Dataformat **DICOM Images (*.dcm.)** and click on the required file name in the File column.



5. Activate **Auto** under Preview.
6. Click on **Open**.
7. The selected image is automatically displayed and you are prompted to scale the image.

For more information, refer to **Scaling images**.

Importing other image formats from a file

To import non-DICOM images into the Orthopaedic Application, proceed in the same way as described under **Importing a DICOM image**

1. Start the Orthopaedic Application.
2. On the vertical toolbar, click on the icon **Insert images**.



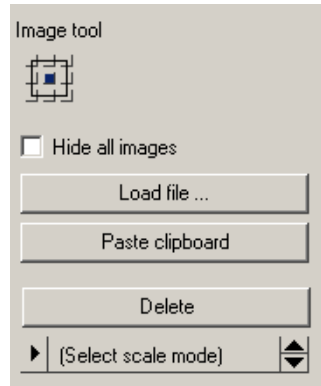
- The **Image Tool** appears, click on **Load File**.
3. Select the drive and the directory where the image is stored.
 4. Select the Data format of the image you want to load and click on the required file name in the File column.
 5. Activate **Auto** under Preview.
 6. Click on **Open**.
 7. The selected image is automatically displayed and you are prompted to scale the image.

For more information, refer to **Scaling images**

Importing images from the Clipboard

To import images that have been copied to the Windows Clipboard:

1. Copy the required images to the Clipboard.
2. Open the Orthopaedic Application.
3. Click on the **Insert image** icon.
The **Image tool** appears.
4. Select **Paste clipboard**.



5. The selected image is displayed automatically and you are prompted to scale the image.

For more information, refer to **Scaling images**.

Scaling images

The images must be scaled to enable measurements to be taken true to scale and to ensure that the prostheses is inserted using the correct scale.

Warning:

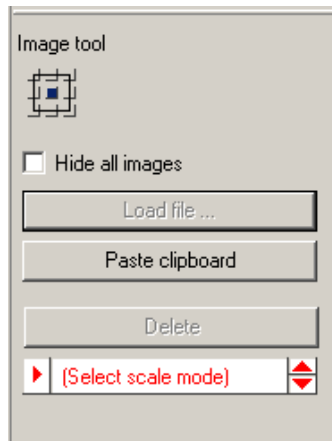
You can only scale the images correctly if a scale bar or a scaling sphere was placed in the image area when the image was taken.

The Orthopaedic Application offers you two methods of scaling:

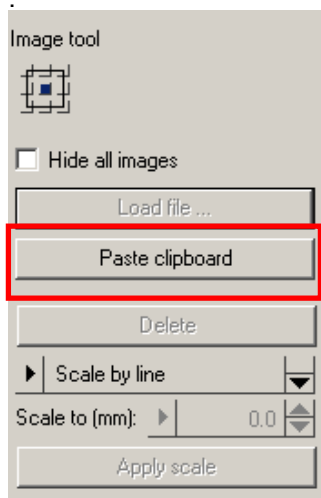
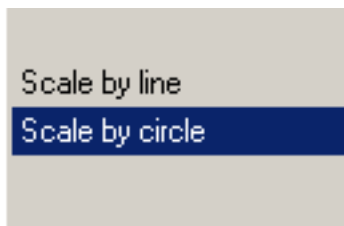
- Scaling with the aid of a circle, for example, when a scaling sphere is visible in the image.
- Scaling with the aid of a distance line, for example, when a scale bar is visible in the image.

Selecting the method

When you import a new image into the Orthopaedic Application, you are automatically prompted to scale the image. For greater accuracy, enlarge the part of the image that contains the reference dimension by clicking on Zoom in or with the scroll wheel of the mouse.



Activate the method that you want to use by clicking on the appropriate button: **Line** or **Circle**.



Scaling with a line

To scale an image with the aid of a line:

1. Click on the start and end points of the distance line that you want to use (for example, along the visible scale bar).
2. Enter the Length in mm and confirm this by clicking on *Apply scale* or *Return*.

Scaling with a circle

To scale an image with the aid of a circle:

1. Select two points on the outer edge of the scaling sphere by clicking on them with the mouse.
2. Drag the circle open with the mouse so that it matches the outline of the scaling sphere.
3. Fix the circle with another mouse click.
4. Enter the Length in mm and click on *Apply scale* or *Return* to confirm.

Warning: The steel ball supplied with the Orthopaedic Application has a diameter of 30 mm.

Correct scaling



To correct the scaling later:

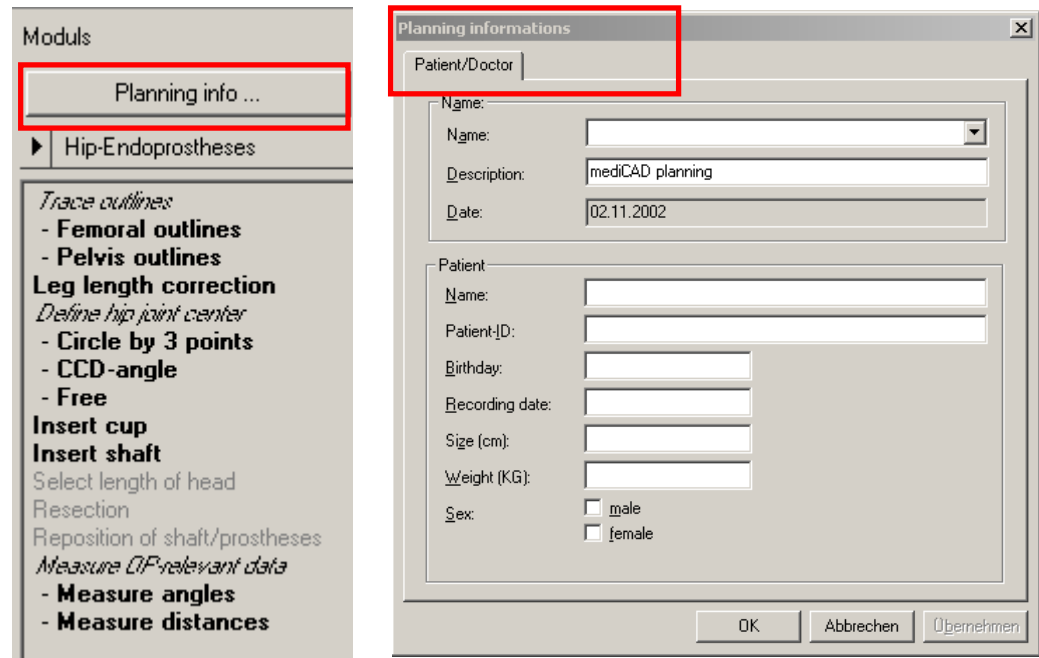
1. Activate the function **Images** of the horizontal tool bar. The **Image tool** is shown.
2. Click with the mouse at any point of the inserted image you want. The function **Select scale mode** is activated.
3. Proceed as described above.

Complete planning data

CAUTION: This is mandatory for legal reasons.

To calculate geometrical parameters and for documentation purposes, information is required about the patient and the physician carrying out the planning. When a new image is loaded, a mask is generated automatically and if available, the information about the patient is taken from the image's DICOM header. You must add some information yourself.

This mask appears automatically whenever you want to save the Orthopaedic Application planning.



Warning: Choose a name that ensures an unambiguous connection between the planning data and the patient, for example, *patient name and date of birth*. Incorrect assignment between the drawing and the patient can have serious consequences.

If you save the planning, you are automatically required to prove and complete the **Planning Information**.

Check the planning information and make any necessary additions such as your **name**.

Details of the height and weight of the patient are essential for **hip biometry**. For **hip endoprosthesis**, you must specify the side on which the prosthesis is to be inserted: left or right.

CAUTION: The data entered in this window from the DICOM header should only be changed in exceptional cases, for example, if you want to save the planning image in an anonym zed knowledge database.

If you change the data, when it is returned to the local database on your PACS System, a new series is created.

Correct planning information

To correct any data later:

1. Click on **Planning Information** of the **Modules tool**.
The dialog window **Planning Information** is shown.
2. Correct or complete the data as described above.

After prostheses templates have been inserted, a mask **Implants** is also generated in which all prostheses data are taken over. Only the final templates are documented. This implant information also includes additional data such as ordering numbers or additional technical information about the inserted prostheses.

Printing and saving

You can print and save the results of your planning at any time, using the Orthopaedic Application.

Printing

You specify the printer that you want to use and the paper format in the print setup.

Before starting to print, choose from a number of Orthopaedic Application-specific options for processing the print job.

Saving

To continue your work at a later date or, if necessary, make corrections, save the planning drawing as a mpl file in the file system on your PC.

When planning is complete, transfer the planning image to the database on your PACS System workstation.

NOTE: When the data is transferred to the database on your PACS System workstation, the graphical objects such as outlines, prosthesis templates, and text are permanently integrated in the images and can no longer be changed.

Printer settings

The printers available for printing are installed at your workstation.



Activate with the **Print** icon on the horizontal toolbar the **Print area tool**. Choose the **Print setup** and select your settings.

For additional print options in **HorizontalToolbar**, refer to **Print**.

Saving

Saving as mpl and as DICOM

The Orthopaedic Application makes a basic difference between images in the Orthopaedic Application format mpl and a final DICOM image.

mpl

To continue working on or correcting the planning drawing at a later date, you must save the drawing as a mpl file.

Note: The planning data is stored on the hard disk of your PC; however, it is not stored in the database of PACS System application.

DICOM

Final plannings should be transferred to the local database on your PACS System

Note: When a drawing is transferred to the local database, the outlines, templates, and text that you have entered are permanently integrated into the image and can no longer be changed at a later date.

Both methods to save are described in **HorizontalToolbar**, refer to **Save**.

Transfer drawing into the database of a PACS System

After completing planning, transfer the planning image to the local database on your PACS or RIS System.

To do this, save the image in DICOM format in an export directory, from where it is retrieved automatically and saved in the database.

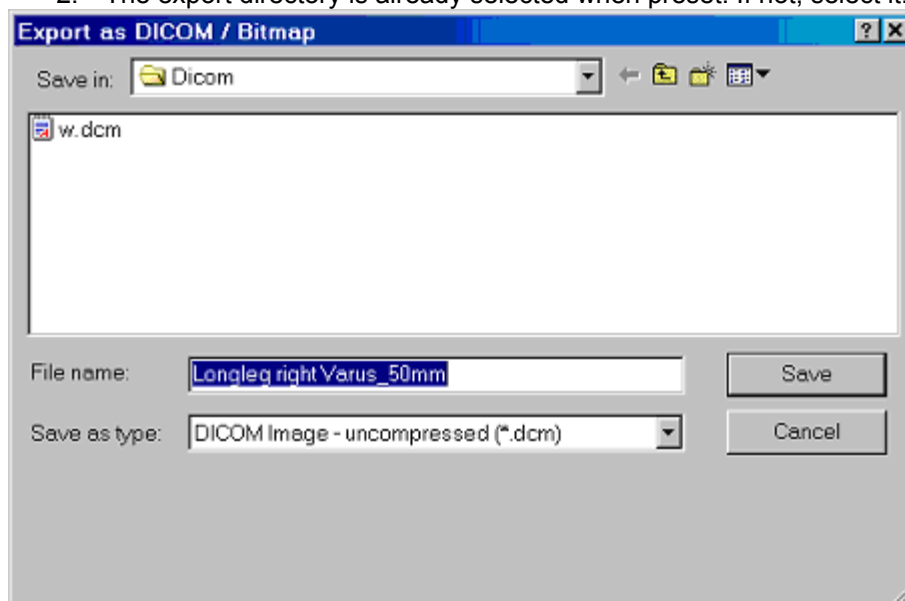
You can then make use of the advantages of DICOM communication and send the planning image in digital form to wherever it is required, for example, the operating theater. You can also transfer the image to a DICOM long-term archive.

NOTE:

When a drawing is transferred to the local database, the outlines, templates, and texts that you have entered are permanently integrated into the image and can no longer be changed at a later date.

Transfer drawing into the database

1. From the Menu, choose **File** and go the **Export as DICOM/Image** function. The **Export as Image** dialog is displayed.
2. The export directory is already selected when preset. If not, select it.



3. Check the **Planning Informations** and confirm with OK.
4. Type in the file name that you want to use. You should only accept the default file name "New Image" if you want to overwrite the existing drawing. Drawings contained in this directory have normally not yet been saved in your local database.
5. Do not change the file type **DICOM uncompressed**.
6. Click on **Save**.
A confirmation query alerts you if a file of this name already exists.
7. Respond to this confirmation query with **No** if you do not want to overwrite the existing drawing, or click on **Yes** if you do want to overwrite the drawing. The drawing is saved as a DICOM image.
8. To exit the Orthopaedic Application, select **File Exit** from the menu. You are asked if you want to save the drawing as a .mpl file.
NOTE: Drawings saved as .mpl files are still available later for modification in the Orthopaedic Application.
9. To confirm the message, click on **Yes** or **No** as required. The Orthopaedic Application is closed.

Saving onto your PACS System

Together with the DICOM image, all information about the patient, the inserted prostheses, and all drawings are saved.

On your PACS System, the planning image is automatically transferred to the local database as a new series for the patient in question and is subsequently deleted from the export directory.

The contents of the database are managed in the Patient List.

Delete drawing

Drawings, which you no longer need, can be deleted from your hard disk by using the MS/Windows-Explorer.

What you delete is the .mpl file, not the DICOM image that you may have transferred to the local database.

Working with Orthopaedic Application Screen layout

The Orthopaedic Application screen is divided into the following areas:

Title bar and menu bar

The title bar shows the name of the program. If you have already saved your planning drawing at least once before, the name of this is also displayed. From the menu bar, you can activate various general functions, for example, the Orthopaedic Application settings.

Note: The Orthopaedic Application is delivered with effective presets. If you lose the presets, a new installation of the Installation-CD is recommended.

Horizontal and vertical toolbars

The horizontal toolbar contains the icons for the general functions that are available to you in all modules.

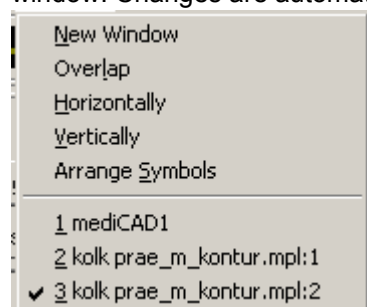
Module and Function Bar

The bar guides you through the work routines step-by-step. The function tools are automatically opened when activating a function.

- Still open steps are **dimmed**.
- Finished steps are not dimmed.
- Step with several options are *in italics*.
- Steps, which you can not activate are in light gray.

Display area

The loaded image is displayed in the display area, where you also edit it. You can divide the display area in several windows. For example, in one window you can edit with a zoom while you see the image overview with the other window. Changes are automatic transferred.

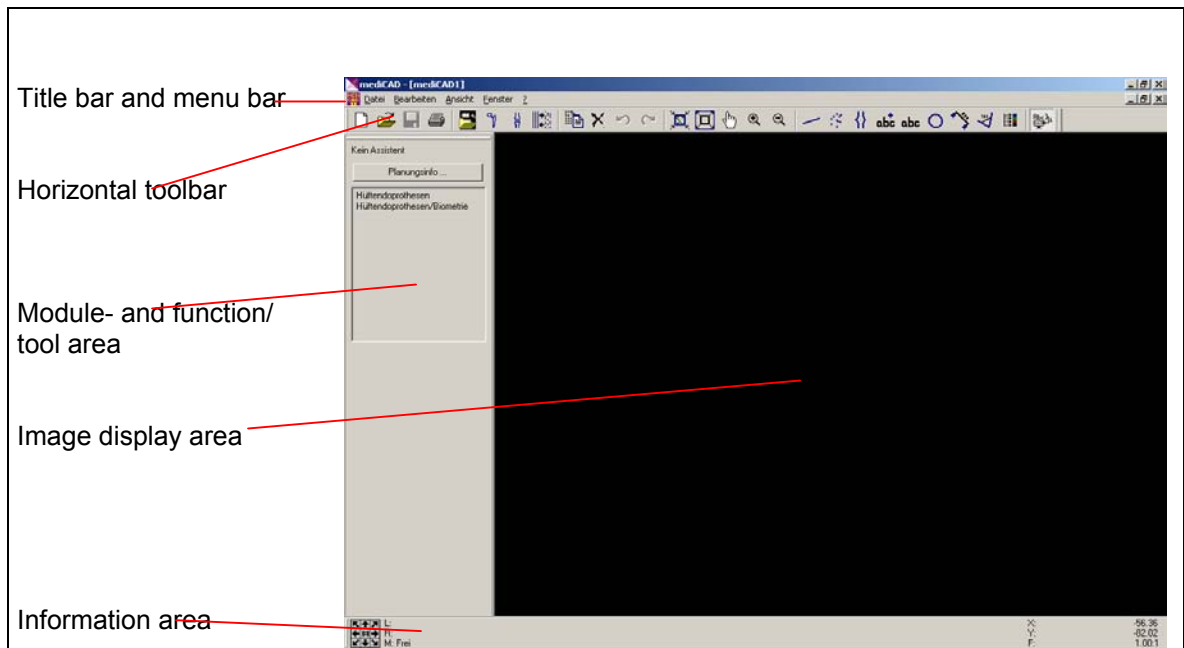


For Settings, select **Window** from the menu bar. The active window has a blue title bar.

Information area

The information area provides information, which makes it easy for you to work with the Orthopaedic Application. For example:

- The function tool guides you step-by-step through all the procedures
- The coordinates of the mouse pointer are shown
- The buttons for moving the displayed image segment are available



Title bar and menu bar

Horizontal toolbar

Module- and function/
tool area

Image display area

Information area

The tool area

The tool guides you step-by-step through all the functions. The step that you must perform next to successfully complete the procedure is shown in the **Information area** (lower screen area).



- L:** Next action with left mouse button
- R:** Next action with right mouse button
where to use the right mouse button:
back means 1 or more steps back
cancel means finish the actual function
finish selection means finish selecting elements
- M** **Drawing mode**, each function has a reselected mode

To change the mode, use the keyboard. Except the **Free** model, all modes are snap-to modes.

Note: The *shift* key must not be activated for setting the mode you want to work with

- Key **E** **End points**—only position points on the end point, for example ends of lines. E is a snap-to element mode.
- Key **F** **Free mode**—position points anywhere you choose.
- Key **L** **Line/Element**—position points on lines of elements, for example on a pelvis line or femur outline. L is a snap-to line mode.
- Key **M** **Midpoint**—only position points on midpoints of lines etc.
M is a snap to mid mode.
- Key **P** **Point**—only position points on defined points, such as the center point of a circle or a cup or a neck of prostheses. P is a snap-to mode.
- Key **S** **Intersection**—only position points on intersections.

More short keys

Note: When setting the mode you want to work with the *shift key* must not be activated

Key **h** Half size of the image, no icon available for this function

Key **a** Full size of the image, same function like this icon



Key **w** To enlarge a certain section of an image you define a window with the mouse same function like this icon



Key **c** Deletes elements, same function like this icon



Key **u** Deletes the latter step you have done, same function like this icon



Key **shift u** One step forward, same function like this icon



↑ 1 smaller size of a prostheses

↓ 1 larger size of a prostheses

- Zoom smaller



+ Zoom large

→ Rotates objects anti clock wise

← Rotates objects clockwise

Planning overview

To plan and document the surgical procedure with the Orthopaedic Application, follow the general procedure described below:

1. Load the image that you want to use for prosthesis planning into the Orthopaedic Application. Alternatively you can load a planning image saved previously to edit it further.
2. Scale the image. You must scale the image so the Orthopaedic Application can insert the selected prosthesis true to scale and determine the correct dimensions
3. Check and complete the **Planning Information**.
4. Select the required processing module and perform the necessary editing steps.
The steps are listed in the **Modules** assistant and are listed according to your used work routine.
 - Still open steps are **dimmed**
 - Finished steps are not dimmed
 - Step with several options are *in italics*
 - Steps, which you can not activate are in light gray

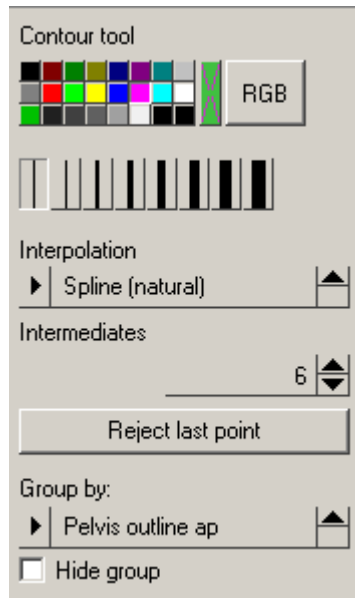
Modules are

- **Hip Endoprosthesis** for targeted prosthesis selection
- **Hip Biomechanics /Biometry** to ensure that implantation is perfectly prepared with respect to biometric criteria
- **Knee Endoprosthesis** for optimum planning of knee prostheses
- **Coxometry** for precise measurement of clinically relevant hip parameters
- **Osteotomy I** for optimum planning of axis correction
- **Osteotomy II** for calculation and correction of complex deformities of the lower limb as Dror Paley. This module is delivered with a separate manual and need and additional training.

When you choose a function or a step, the **Tool Assistant** according to the function opens and shows all options you may have with that specific function.

For example:

You draw outlines of femur or tibia—the **Contour Tool** opens.



You can choose colors and the size for your line, the kind of line like spline or polyline, the number of intermediate points (preset with six points), and the group to which the line should belong to like femur-outline or pelvis-outline.

Later on you can fade in or out if you temporarily do not need the line or contour.

For nearly each function the Orthopaedic Application offers you the special tool for your convenient use.

You can skip steps, which you do not want to proceed.

You can follow steps in another sequence than listed.

You cannot follow steps, which are light gray and not activated. Those steps need a proceeding function.

After you have deleted a step/Function, it is listed **dimmed** again

You can also use functions in your **Horizontal Toolbar** without using the **Module tools**

5. Define dimensions relevant during the operation.
6. Print and/or save as mpl or DICOM.
When planning is completed, transfer the planning image to the database on your workstation.

Often used functions

Delete elements

Procedure:

Click on **Delete**.



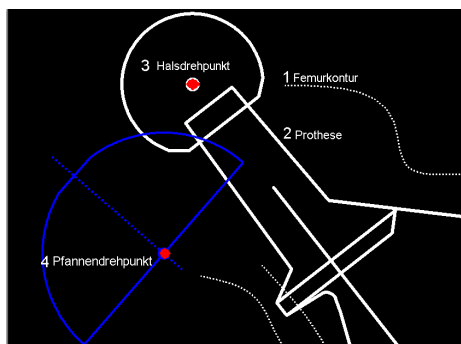
	L: Delete element or define first corner of area R: Back M: Element or Line	Contours
<p>L ● To select the element you want to move. or</p> <p>L ● Use the mouse to drag open an area covering the required image section.</p>		
<p>Note: With Single Items you can also delete labeling of prostheses.</p>		

Move, copy and rotate elements and prostheses

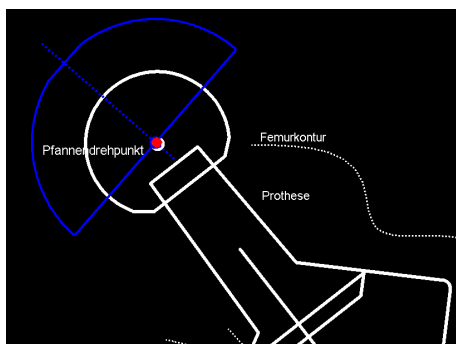
For example:

The prostheses must be fitted in the cup in such a way that the center of rotation of the prostheses head and the cup center are congruent.

Pre-position



Post- position





Procedure

Click on **Move**.




	L: Select element or define first corner of area R: Exit function M: Element or Line	Move
<p>L ● To select the elements you want to move or drag a window around them use the left the mouse pointer. first—element is the prostheses second—element is the femur outline</p>		

	L: Select element or define first corner of area R: Finish selection M: Element or Line	Move
R	To finish the selection process, use the right mouse button. Note: The selection of all elements to be moved has to be finished to go on with the procedure.	
	L: Grab point R: Exit function M: Free	Move
L	To select the reference point (for example, the center point of the prostheses neck as grab point), use the left mouse button.	
M	Using Free mode, position the cursor anywhere you choose. Note: Press the P key and change to mode Point . Coming near to it you subsequently you can snap-to the center point of the prostheses neck.	

The selected elements (for example, the femur contour with the prostheses are connected) can be moved by moving the mouse.


and rotated by pressing the key ← or →.


For changing the size of the prostheses press the keys ↓ or ↑.

	L: Destination point R: Back M: Free	Move
L	To select the destination reference point (for example, center point of the cup), use the left mouse button. Align the selected objects in such a way the point of references coincide.	
R	To return to the Module too , use the right mouse button.	
M	With Free mode you can position the cursor anywhere you choose. Note: Press the P key and change to mode Point . Coming near to it you subsequently can snap-to the rotation point of the cup.	

Changing text

Existing and automatically inserted text can be changed, moved, and rotated.

Click on **Edit text** 

	L: Select text to edit R: Exit function M: Element or Line	Edit text
L	To select the text, use the left mouse button.	
L	To pickup the text, move, or rotate it, use the left mouse button.	
L	To set it at the new position, use the left mouse button.	
R	To quit this function, use the right mouse button.	

Change existing text



Go to this function, click on the text you want to change or modify and the text tool automatically opens. Go to the text in the text tool and change it.

To shift or rotate the existing text with the same function, click on it twice.

Write new texts



With the editor of the text tool you write and place your text.

Zoom Pan



Description of the function

When activating this icon (even while you work in another function), you can grab and move the complete image.



You do not need to quit the function you worked with before. Use the Zoom Pan in addition to the other function.

NOTE: When you finished, you must quit the Zoom Pan with the **right** mouse click. You can continue working with in the module.

NOTE: As you move the image, you can enlarge or scale down the image by scrolling the mouse wheel.

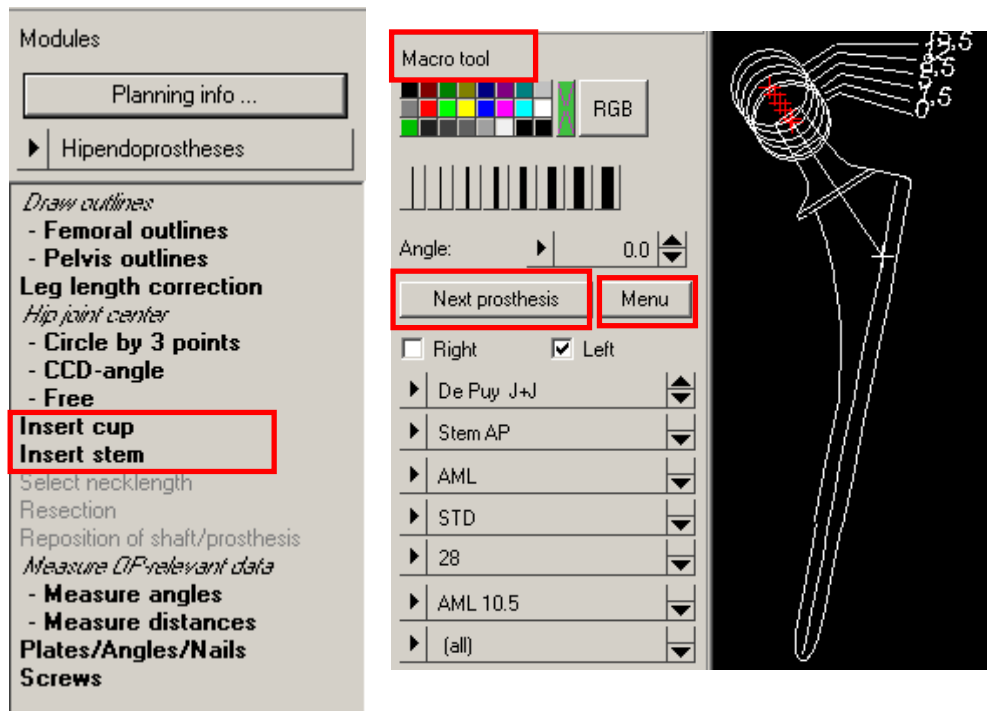
Procedure:

Activate the icon and proceed according to the order in the information area.

	L: Grab point R: Exit function M: Free	Zoom Pan
L	To take the image/element and move to the required position, use the left mouse button.	
	L: Destination point R: Exit function M: Free	Zoom Pan
L	To position the image at the destination, use the left mouse button.	
R	To quit the function, use the right mouse button.	

NOTE: This function interrupts the procedure of all actual functions you are working on. To return to the previous function, exit the Zoom Pan with the right mouse button. You can then proceed.

Insert a prostheses



Your database contains prostheses templates of various types, models, and sizes from different manufacturers.

When you activate (for example, the function **Insert cup**) the **Macro tool** for prostheses automatically opens.

Attached to the mouse pointer is the prostheses type you used last.

With the function **Next prosthesis**, add the next prostheses.

If you do not activate **Next prosthesis** and change type or size, the actual choice is attached to the mouse pointer.

The Orthopaedic Application offers two kinds of selection:

Selection from a **Menu (listing)**

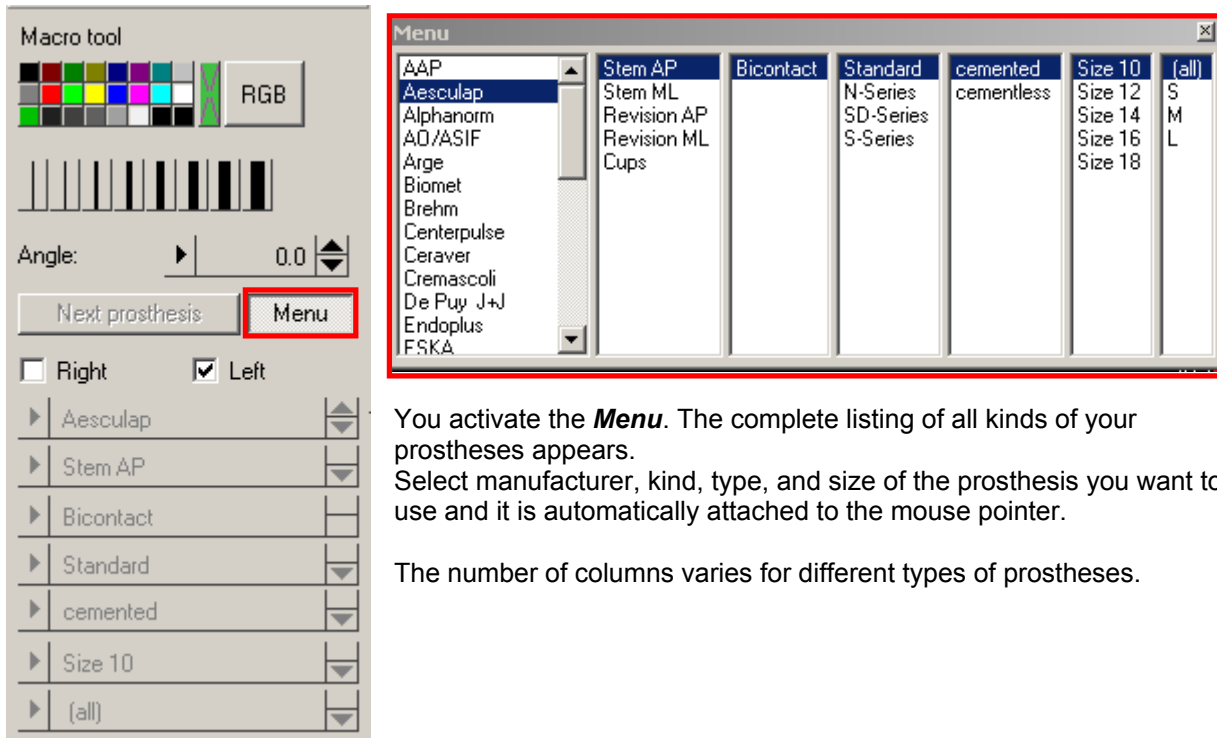
or

Selection from a **pull-down-menu**

WARNING:

All dimensions and measurements given by the Orthopaedic Application prostheses database derive from original manufacturers data or templates. An exemption from liability exists for incorrect or false original prostheses manufacturer data.

Select from the **Menu** (listing).



You activate the **Menu**. The complete listing of all kinds of your prostheses appears. Select manufacturer, kind, type, and size of the prosthesis you want to use and it is automatically attached to the mouse pointer.

The number of columns varies for different types of prostheses.

	L: Drag and drop macro	Macro tool
	R: Confirm macro	
	M: Free	

- L** ● To position the prostheses, use the left mouse button.
- L** ● To pick up the prostheses again and move it to another position, use the left mouse button. If preliminary set, change it by going to another prostheses of your choice inside the **Menu**.
- R** ● To confirm the chosen prostheses and exit the function, use the left mouse button.

If you exit the function and want to change the prostheses again or to position it somewhere else, use **Delete** or **Move**.

With the function **Next prosthesis**, add the next prosthesis while the previous prosthesis is finally positioned.

For example:

- Choose a cup.
- Position it.
- Go to **Next prosthesis**.
- Choose the stem.
- Position it and confirm.

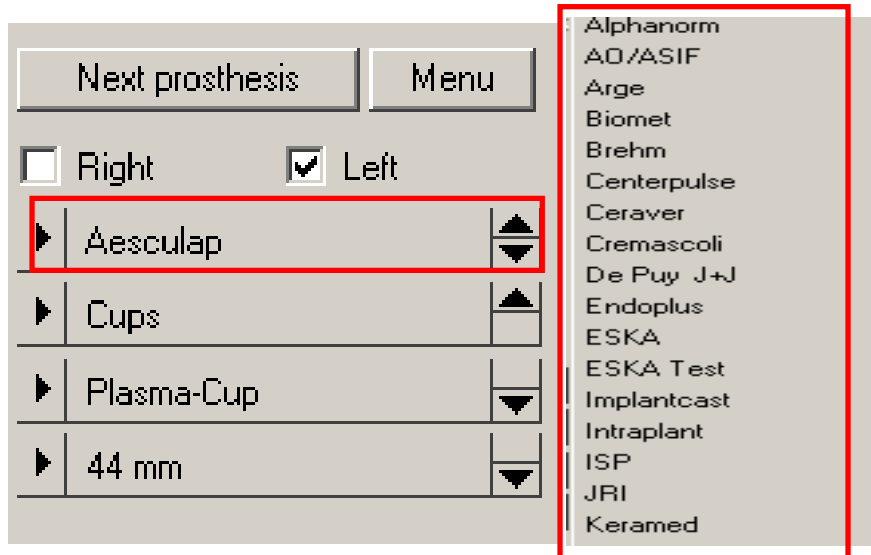
Note:

If the prostheses is **not finally positioned**, you can move, rotate, or change the prostheses by picking it up by clicking on the left mouse key.

The prostheses is only applied after you have positioned it again (with the left mouse click) and then click on the right mouse key to confirm.

Exception: Screws are always positioned with a starting point and an endpoint. They have various lengths corresponding to the mouse position and are finally set with the endpoint. If positioned, you cannot move them. Changes can only be done by **Deleting** and insert a new one, or **Move**.

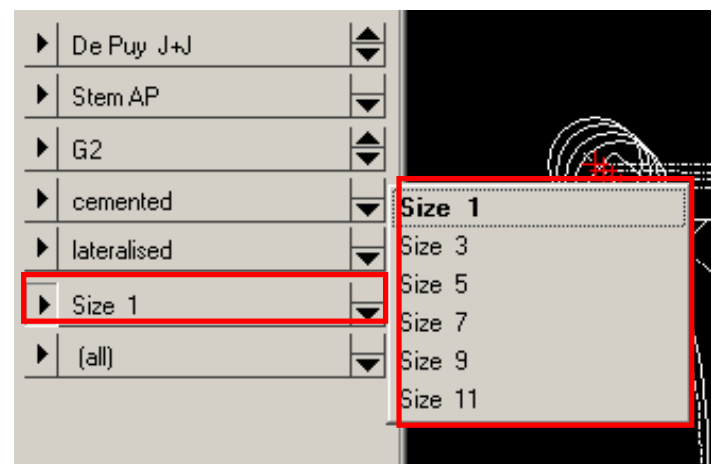
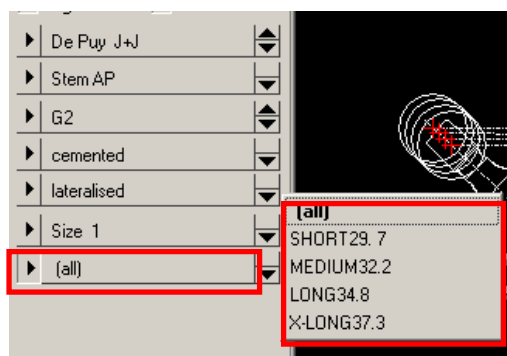
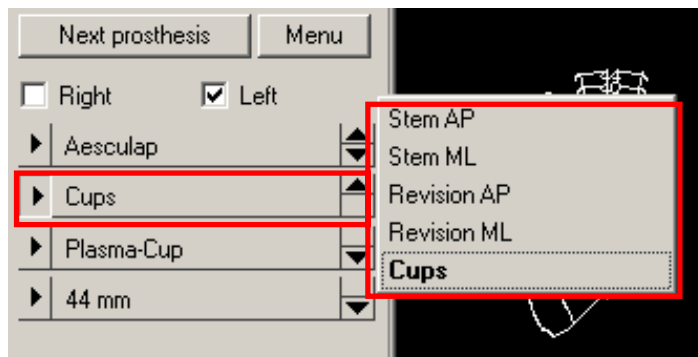
Selection from the *pull-down menu*.




Only by touching one of the different items like:

- manufacturer
- kind of prosthesis
- type of prosthesis
- size of prosthesis

The following window opens for your further selection. You determine the sequence to continue with for your selection. The result of your selection is shown automatically at the mouse pointer and on the **Macro tool**.



	L: Drag and drop macro R: Confirm macro M: Free	Macro tool
-----------------------------------------------------------------------------------	-------------------------------------------------------	------------

L● To position the prostheses, use the left mouse button.

L● To pick up the prostheses again and move it to another position, use the left mouse button.
If it is preliminary set, you can change it by going to another prostheses of your choice inside the **Menu**.

R● To confirm the chosen prostheses and exit the function, use the right mouse button.

If you exit the function and want to change the prosthesis again or to position it somewhere else, you can only do this by a **Delete** or a **Move**.

With the function **Next prosthesis**, add the next prosthesis while the previous prosthesis is finally positioned.

For example,

- Choose a cup.
- Position it.
- Go to **Next prosthesis**.
- Choose the stem.
- Position it and confirm.

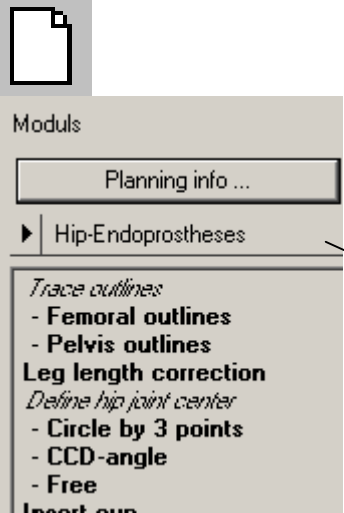
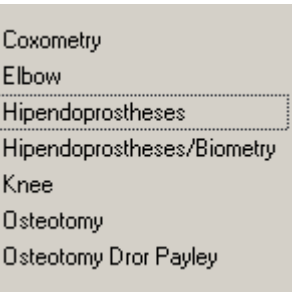
NOTE:


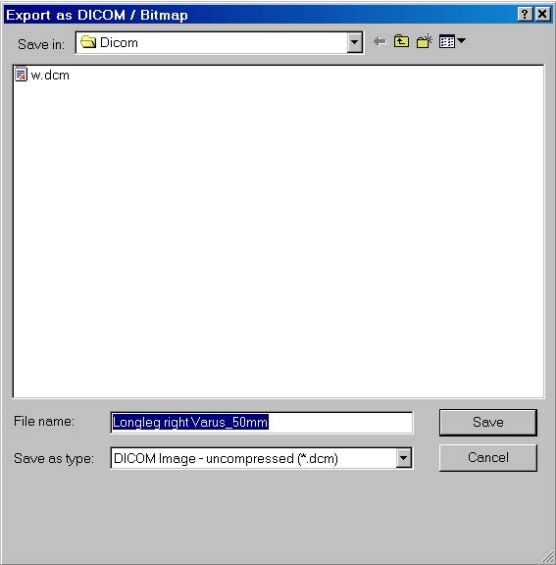
If the prostheses is **not finally confirmed**, you can move, rotate, or change the prosthesis by picking it up with a click on the left mouse key.

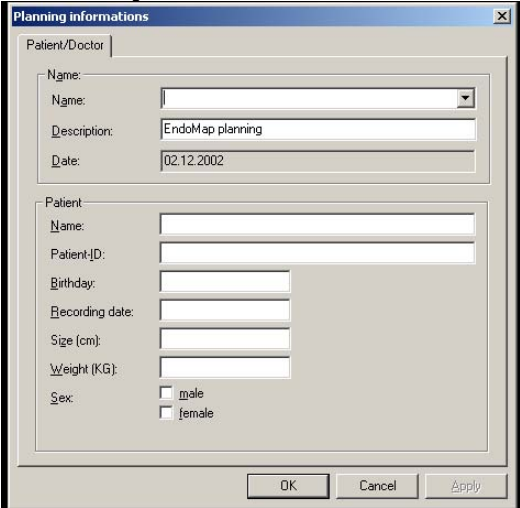
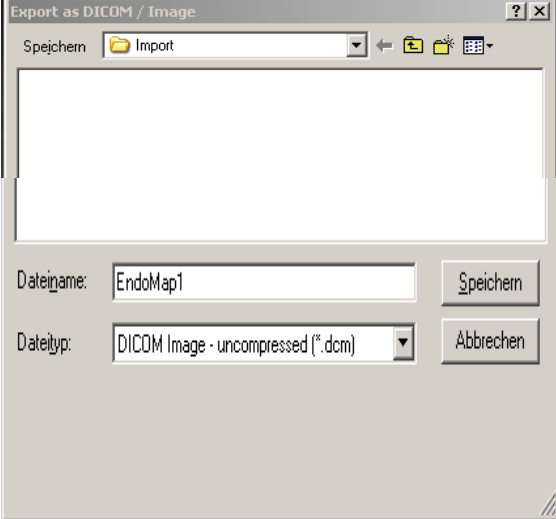
The prosthesis is only confirmed after you have positioned it and then clicked on the right mouse key.

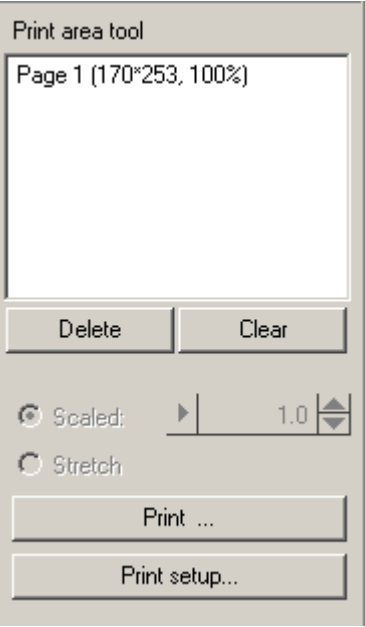


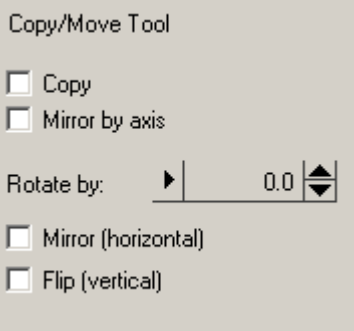
Exception: Screws always are positioned with a starting point and an endpoint. They have various lengths corresponding to the mouse position and are finally set with the endpoint. If positioned, you cannot move them. Changes can only be done by **Deleting** and inserting a new one, or **Move**.




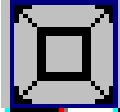
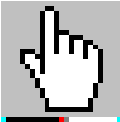

Horizontal toolbar

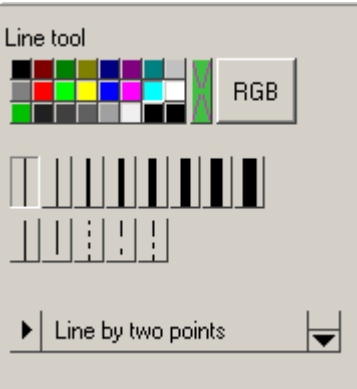

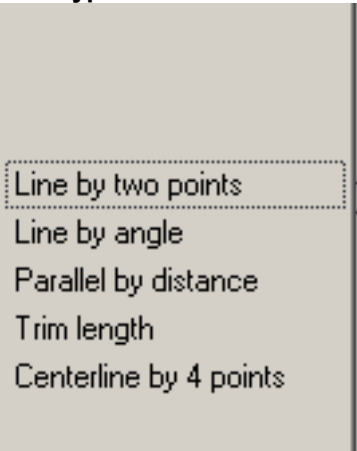
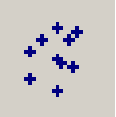
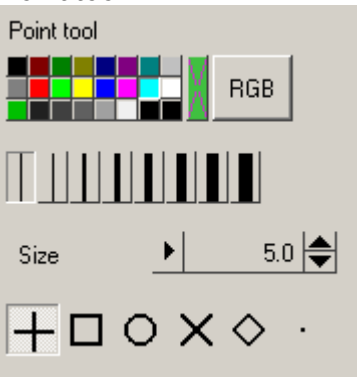

<p>New</p>  <p>Moduls</p> <p>Planning info ...</p> <p>▶ Hip-Endoprostheses</p> <p><i>Trace outlines</i></p> <ul style="list-style-type: none"> - Femoral outlines - Pelvis outlines <p>Leg length correction</p> <p><i>Define hip joint center</i></p> <ul style="list-style-type: none"> - Circle by 3 points - CCD-angle - Free <p>Insert cup</p>	<p>New</p> <p>Open a new, empty document into which you write your planning. Simultaneously you can load and work on several documents with various or identical original images (DICOM, bmp, etc.) or plannings (mpl= Orthopaedic Application planning format).</p> <p>Planning information You get a mask with patient relevant data.</p> <p>Module tool With this tool, choose the required module to work with. For example, Hipendoprostheses, Coxometry, etc.</p>
<p>Modules</p>  <p>Coxometry</p> <p>Elbow</p> <p>Hipendoprostheses</p> <p>Hipendoprostheses/Biometry</p> <p>Knee</p> <p>Osteotomy</p> <p>Osteotomy Dror Payley</p>	<p>Modules</p> <p>Choose the required module.</p>

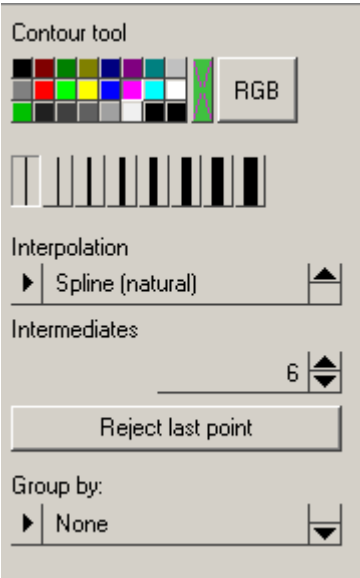

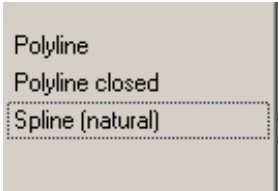
<h3>Insert Images</h3>	<h3>Insert Images</h3>
<div data-bbox="191 342 553 800"> <p>Image tool</p>  <p><input type="checkbox"/> Hide all images</p> <p>Load file ...</p> <p>Paste clipboard</p> <p>Delete</p> <p>▶ [Select scale mode] ▼</p> </div> <div data-bbox="185 835 748 1050" style="background-color: yellow;"> <p>Warning: You can only scale the image correctly if a scale bar or a scaling sphere was placed in the image area while the image was exposed. Check your measurements carefully. False values can have serious consequences for the patient regarding misinterpretations of the right prostheses size.</p> </div> <div data-bbox="191 1083 743 1644">  </div>	<h3>Image tool</h3> <p>Defined alignment of the image on the screen. Hide all images fades out the x-ray so that only the graphics of the Orthopaedic Application remain visible.</p> <ul style="list-style-type: none"> • Opens the dialog to choose an image. • Loads an image from a file. • Pastes an image out of a clipboard. • Delete selected images. <p>After loading an image the Select scale mode blinks. Choose the required mode and scale the image. Without this calibration you cannot continue to work.</p> <p>If another link to a store is wanted, define your actual register name, file name, and type of data format.</p>

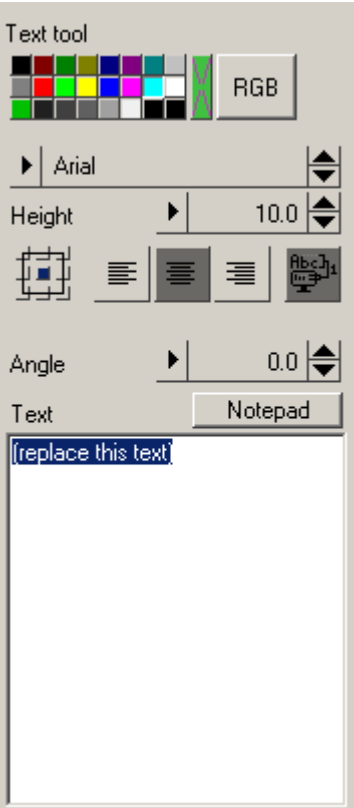

<p>Open</p>	<p>Open Open an image including a planning with graphics to continue, correct, complete, or view.</p>
<p>Save</p>	<p>Save</p>
<p>Patient/Physician</p> 	<p>Patient/Physician</p> <p>Warning: Check all items carefully. False information can cause severe problems. The following details must be filled in always: physician name patient name patient date of birth</p> <p>Working with the module Biometry, add information for size and weight of the patient</p> <p>Working with the module Coxometry, add the recording date of the image</p>
<p>Export as DICOM / Image</p> 	<p>If you save the planning as DICOM to the database on your PACS System, the planning is stored and cannot be changed later on.</p> <p>Procedure. Go to the menu bar and click on File. Activate the function Export as DICOM/image. Choose the right data format and type in the file name you want to use.</p> <p>Warning: Choose a name that ensures an unambiguous connection between the planning data and the patient. For example, patient name + date of birth</p> <p>Prove all data carefully. Incorrect assignment between the drawing and the patient can have serious consequences for the patient.</p>

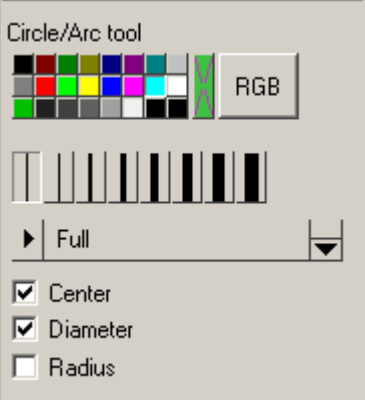

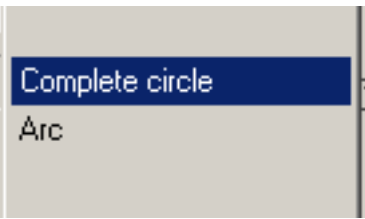
<p>Print</p>	<p>Print</p>
<p>Print area tool</p> 	<p>Print area tool</p> <p>Already defined print areas</p> <p>Delete—Marked print areas Clear—Delete all print areas</p> <p>Scaled—Determines the size of the image section that is printed when you click on the Print button. The larger the magnification factor, the smaller the printed image section is.</p> <p>Stretch—The section to be printed can be chosen as required.</p> <p>Print—Print the defined section.</p> <p>Print setup—Opens the standard Print Setup dialog window.</p>
<p>Select Size(Shaft/Head/..)</p> 	<p>Select Size(Shaft/Head/..)</p> <p>This function selects the sizes of hip heads or width of stems or nails, length or width.</p>
<p>Move/Copy/Mirror/Rotate</p> 	<p>Move/Copy/Mirror/Rotate</p> <p>The required object can be moved, copied, mirrored, and rotated according to the functions chosen with the Copy/move tool.</p>
<p>Copy/move tool</p> 	<p>Copy/move tool</p> <p>The shown functions can be used single or in combination</p> <p>Copy: You mirror the required objects and display it in addition to the original.</p> <p>Move Used as a single function, the required object is only moved to another position. Used in combination with another function, the object is copied and mirrored by an axis.</p> <p>Mirror by axis The required object can be mirrored by an axis, which you define by your own choice.</p> <p>Mirror horizontal or flip vertical Displays the required object above or below of the original.</p>

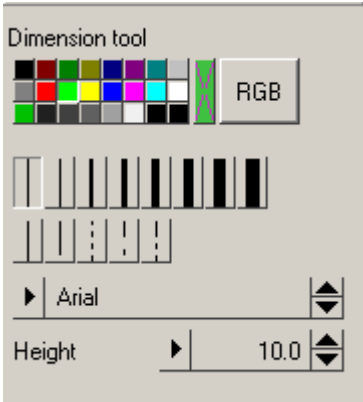




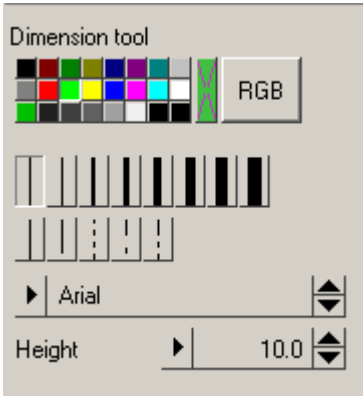



<p>Delete</p>  <p>Delete tool</p> <p><input checked="" type="checkbox"/> Single items</p> <p>▶ (select group) ▲▼</p> <p>Delete group</p>	<p>Delete</p> <p>Deleting groups or single elements</p> <p>Objects consist of several elements. Several elements may belong to a group. For example, a template and the label. A template (Macro) consists of several lines (elements)</p> <p>If Single items is activated, delete single elements as labels or lines or measurements.</p> <p>Select group means to select the required group (macro). Deletes the selected group.</p>
<p>Undo and redo</p> 	<p>Undo and redo (cancel and restore)</p> <p>You can undo as many steps you want. Redo restores the canceled steps.</p> <p>Same functions are activated by keys: Press u for <i>undo</i> or press shift u to restore the last canceled step.</p>
<p>Zoom all</p> 	<p>Zoom all</p> <p>The size of the planning image is adjusted to fill the display area.</p> <p>Same functions are activated by keys: Press a for all.</p>
<p>Zoom rectangular</p> 	<p>Zoom rectangular</p> <p>You can enlarge a certain section of an image by using the mouse to drag open a box covering the required image section.</p> <p>Same functions are activated by keys: Press w for window and draw the rectangle.</p>
<p>Zoom Pan</p> 	<p>Zoom Pan</p> <p>Drag and drop the image to a new position.</p> <p>At the same time, you can enlarge/scale down the image with the scroll wheel of your mouse or with the keys:</p> <p>+ and -</p>
<p>Zoom in and Zoom out</p> 	<p>Zoom in and Zoom out</p> <p>The screen is enlarged or scaled down step by step.</p> <p>Same functions are activated by keys</p> <p>+ and - or by the scroll wheel of your mouse</p>

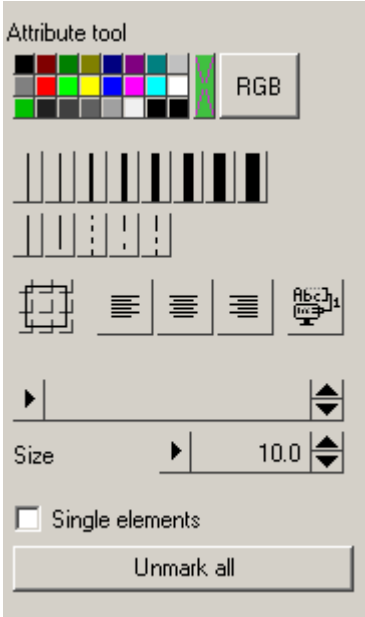



<p>Lines</p>	<p>Drawing lines</p>
<p>Line Tool</p> 	<p>Line Tool</p> <p>Select the required color:</p>  <ol style="list-style-type: none"> 1. By the palette 2. Select the inverse color (as photo negative) 3. Free choice of RGB colors <p>Choice of line width</p> <p>Choice the line type</p>
<p>Line type</p> 	<p>Line types:</p> <p>Line with a starting and terminator point.</p> <p>Line in a defined angle to a reference line. The angle is your choice.</p> <p>Parallel line in a defined distance to a reference line. The distance in mm is your choice.</p> <p><i>Trim:</i> change line length</p> <p>An axis or midline is drawn automatically defined by four points surrounding it.</p>
<p>Points</p> 	<p>Draw points</p> <p>All kinds of points can be drawn.</p>
<p>Point tool</p> 	<p>Point tool</p> <p>Select the required color:</p>  <ol style="list-style-type: none"> 1. By the palette 2. Select the inverse color (as photo negative) 3. Free choice of RGB colors <p>Choice of line width</p> <p>Choice of size</p> <p>Type of the point, single or in combination</p>

Outlines	Draw outlines
<p>Contour tool</p> 	<p>Contour tool</p> <p>Select the required color:</p>  <ol style="list-style-type: none"> 1. By the palette 2. Select the inverse color (as photo negative) 3. Free choice of RGB colors <p>Choice of line width</p> <p>Choice of the contour type:</p>  <ul style="list-style-type: none"> - Polyline - Polyline closed - Spline (natural) <p>Intermediates—means how accurate the spline is drawn. This value is preinstalled.</p> <p>Reject last point. NOTE: You can also activate this function by pressing the backspace key (above the return key).</p> <p>Group by Define the Group to which the drawn contour should belong. Several single contours are arranged to a group (group=macro). The group has to be defined before you start drawing the outline.</p> <p>Note: Together with the <i>Modules tool</i>, the group is preinstalled: To correct a line of a group afterwards, you must activate the right group to which the corrected line should belong to. You work with the module <i>HIP Module</i> first. group = femur shaft second group = pelvis</p>

<p>Create Text + and Edit Text</p>	<p>Create text</p>
<p>Text tool</p> 	<p>Text tool</p> <p>Select the required color:</p>  <ol style="list-style-type: none"> 1. By the palette 2. Select the inverse color (like photo negative) 3. Free choice of RGB colors <p>Chooses the type of characters</p> <p>Define the size of characters</p> <p>Choose the block- or text adjustment</p> <p>The text changes proportionally to the zoom in or zoom out of the image section, or the size of the text does not change when you zoom in or zoom out.</p> <p>Define the angle of rotation for the text.</p> <p>Notepad An additional section of an editor opens to edit more text.</p> <p>Small editor segment</p>

<p>Circles</p>	<p>Circles</p>
<p>Circles/arc tool</p> 	<p>Circles/arc tool</p> <p>Select the required color:</p>  <ol style="list-style-type: none"> 1. By the palette 2. Select the inverse color (like photo negative) 3. Free choice of RGB colors <p>Define the size of the line.</p> <p>Choose a complete circle or only an arc (refer to below).</p> <p>In addition to the circle, choose the center point, the diameter, or the radius. The functions can be combined.</p>
	<p>A complete circle has 360°</p> <p>An arc can be created out of a complete circle. The required arc is generated by drawing the required segment counter clockwise to the circle. The segment of the circle not required is deleted.</p>

<p>Dimension parallel</p>	<p>Draw dimensions parallel</p>
<p>Dimension tool</p> 	<p>Dimension tool Select the required color:  1. By the palette  2. Select the inverse color (like photo negative)  3. Free choice of RGB colors</p> <p>Define the size of the line. Choose the type and size.</p>
<p>Dimension angle</p> 	<p>Dimension angle</p> <p>Define the dimension of an angle.</p> <p>NOTE: Angles are always defined counter-clockwise to the reference lines.</p>
<p>Dimension tool</p> 	<p>Dimension tool Select the required color:  1. By the palette  2. Select the inverse color (like photo negative)  3. Free choice of RGB colors</p> <p>Define the size of the line. Define type and size of the text.</p>

<p>Attributes</p>	<p>Attributes</p>
<p>Attribute tool</p> 	<p>Attribute tool</p> <p>Select the required color:</p>  <ol style="list-style-type: none"> 1. By the palette 2. Select the inverse color (like photo negative) 3. Free choice of RGB colors <p>Define the size of lines.</p> <p>Choose the block or text adjustment if active.</p> <p>The text changes proportionally to the zoom in or zoom out of the image section or the size or not.</p> <p>Text size can be changed.</p> <p>If activated, colors and size of single elements such as labels on prostheses, single lines of prostheses, or single lines of contours can be changed.</p> <p>Marked objects can be unmarked all at once.</p>
<p>Allow/disallow Fixed font sizes</p> 	<p>Allow/disallow fixed font sizes</p> <p>Choice of the function to change/not to change the text proportionally to the zoom in or zoom out of the image section</p> <p>If this function is activated, all text blocks are displayed in the preselected size, independent of the zoom in or zoom out.</p>
	

Explanation of Fixed font size

Generally, the size of the text is zooms in or out when the image section is zoomed in or out.

If the text has the attribute **Fixed font size**, zooming in or out of the image section does not change the size.

This means that you can always read the text.

The Orthopaedic Application has preinstalled **Fixed font sizes** for the prostheses labels and measurements. You can change this with the **Attributes tool** or the **Text tool**.

The meaning of Fixed font size

Where is the function relevant?

The feature **Fixed font size** can be activated for:

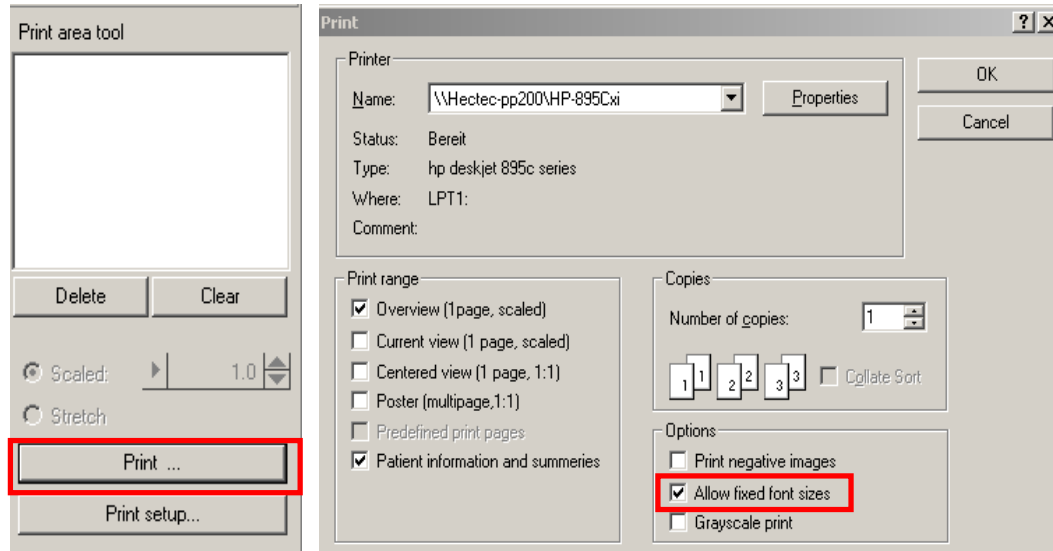
- Screen
- Printer
- Image export

Where can the function be set?

For the **screen**, activate the function with the **Horizontal toolbar**.



For the **printer**, activate the function with the **Print area tool** and the function **Print**.



For **DICOM-/Image-export**, activate the function with the **Menu bar** → **File** → **Settings**.



Which settings are effective when installed?

The original settings of the Orthopaedic Application are:

- For the screen **Fixed font size** are allowed (activated)
- For print **Fixed font size** are not allowed (deactivated)
- For DICOM-/Image-Export **Fixed font size** are allowed (activated)

You decide which settings are the best for your work with the Orthopaedic Application. The settings you made last are stored and remain activated for the next program start.

Procedures step by step

Hip Endoprostheses

Basics

The Endoprosthetics module supports you in the planning of hip implants. It is based on current planning methods in hip endoprosthetics—formerly applied manually—using x-rays and prosthesis templates.

Perform all these tasks quickly and accurately:

- Select and fit a suitable cup and prosthesis.
- Determine the pelvic torsion.
- Calculate the leg length adjustment and visualize it on the image.



Images

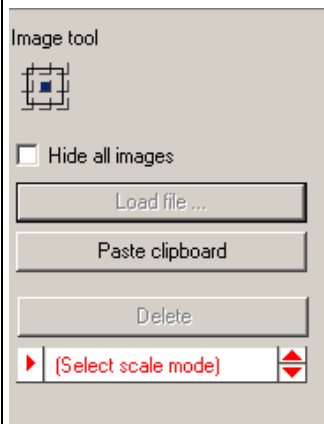
The basic requirements for planning a surgical procedure are x-rays taken according to the following criteria:

- Symmetrical positioning of the pelvis
- Hip joints in a neutral position
- Longitudinal axis of the femur parallel to the image receptor plane
- Patella in the zero position
- Central ray beam on femoral head center or symphysis
- Lead sphere of known size or scale bar at the level of the femur shaft as a calibration aid

NOTE: When taking the x-ray, avoid oblique positioning, abduction, or external rotation of the legs. Otherwise, the optimum rotation center of the endoprosthesis cannot be determined accurately.

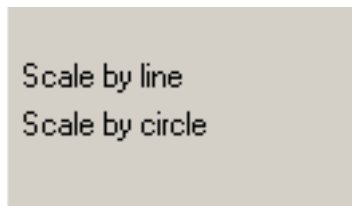
Procedure

	<p style="text-align: right;">Step 1 Image selection 1</p> <p>Select the image and scale it. This function inserts original images only.</p>	
	<p>L: Select image to move or to scale R: Exit function M: Element or Line</p> <p style="text-align: right;">T:\medicAD\bilder\perthes\Bild3.bmp</p>	
<p>L ●</p>	<p>To take the image and position it, use the left mouse button.</p>	
<p>R</p>	<p>To exit the function, use the right mouse button.</p>	
<p>M</p>	<p>Not relevant</p>	

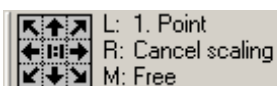
Step 2 Select scale mode **2**

The function **Select scale mode** is activated and flashes.

Select the scale mode and scale the image with the reference, which is visible on the screen.



- With the aid of a distance **line** when a scale bar is visible
- With the aid of a **circle** when a scaling sphere is visible on the screen



L • To define the first point of a line or the edge of a circle, use the left mouse button.

R To exit the function, use the right mouse button.

M Define the position of the point **Free** of your choice.



L • To define the second point of a line or at the edge of a circle, use the left mouse button.

R To return to the first point, use the right mouse button.

M Define the position of the point **Free** of your choice.

If you scaled with the aid of a line, scaling now is done.

If you scale with the aid of a circle, complete the circle with the third point.



L • To define the third point of the edge of a circle, use the left mouse button.

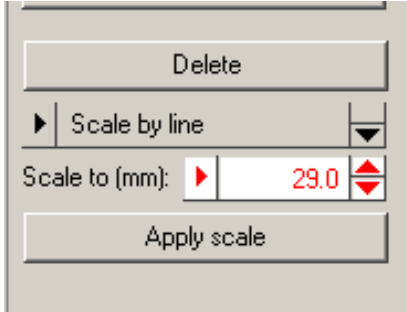
R To return to the first point, use the right mouse button.

M Define the position of the point **Free** of your choice.

T:\mediCAD\bilder\3

Step 3 Scaling measurement in mm **3**

Fill in the correct measurement of the reference.



Warning: You can only scale the image correctly if a scale bar or a scaling sphere was placed in the image area while the image was exposed. Check your measurements carefully. False values can have serious consequences for the patient regarding misinterpretations of the right prostheses size.

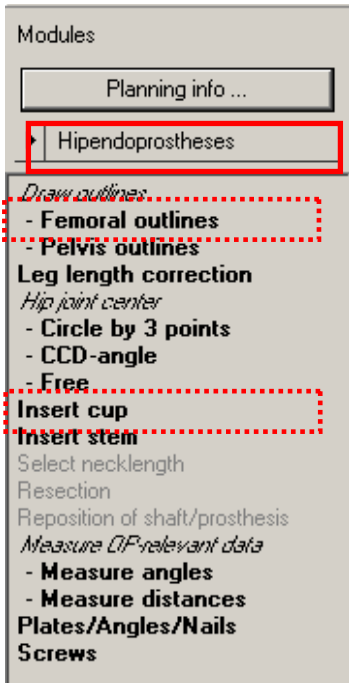
Confirm with **Apply scale** or **Enter**.

Note:

After you scaled the image correctly, press the right mouse button to exit the function.



Step 4 Select module **4**



Choose the required module to work with.

The **Hipendoprosthesis Tool** is activated. You can exit this module at any time to select another module.

By activating the next steps of the menu, you get automatically into the right function tool and are guided by the **Information bar**.

The support given by the **Information bar** is described next.

Step 5 Draw contours **5**

- Femoral outlines
- Pelvis outlines

Leg length correction

Requirement: A scaled image

Result: The femur outline or the pelvis outline is drawn by clicking on several intermediate points on the bone outline.

You are in the **Contour tool**.

The femur outlined is four lines.

After you select the kind, color, and size of the line, click one point after the other, following the contour. The spline function requires less intermediate points for straight lines than for curves.

NOTE: To reject points, go to the **Reject points** function or press the backspace key (above return).

Reject the point step-by-step and continue drawing.



L: first point
R: Exit function
M: Free

Contours

L To define the first point of the femur outline (for example, start drawing the lateral outer corticalis), use the left mouse button.

R To exit the function, use the right mouse button.

M Define the position of the point **Free** of your choice.



L: next point
R: next contour
M: Free

Contours

Press backspace to reject the last point

L To define the next point of the outline, use the left mouse button.

R To finish the line and start the next (for example, the lateral inner corticalis), use the right mouse button.

M Define the position of the point **Free** of your choice.

You draw the medial inner and outer corticalis in the same way.

R With the first mouse click, you finish the line.

R With the second mouse click on the image, you exit the function.

NOTE: If you forgot one outline or you deleted one to draw it again, go to the **Femoral outlines** function, select the **Group by** → **femur outline ap** function, and repeat drawing as described above.

To draw a pelvis outline, do the same with the function **Pelvis outlines**.

The femoral and/or pelvis outlines are displayed.

After exiting, go to the next dimmed written function.

Step 6 Leg length correction **6**

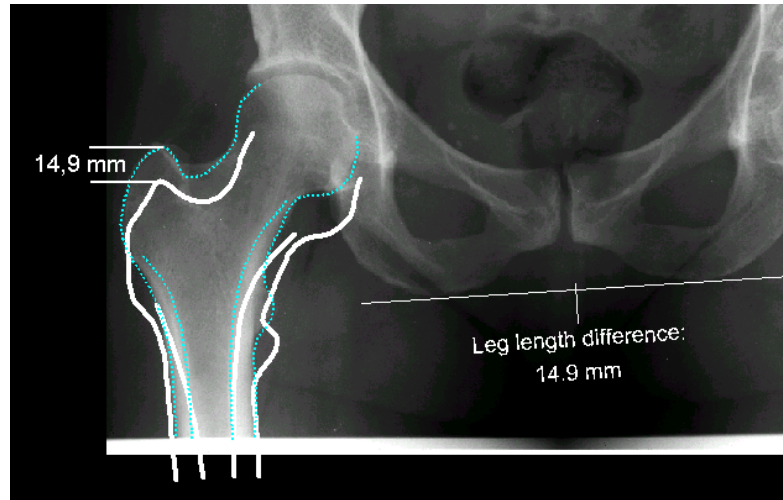
Leg length correction

Define hip joint center

Requirement: The femoral outline of the pathological leg

Note: With this function, you do the measurement of the leg length difference and the correction all at once. For measurement only, you do not need to draw the outline.

Result: The function calculates the leg length difference automatically. After all necessary mouse clicks are done, the complete femoral outline automatically moves cranial or caudal.



After you select the kind, color, and size of the line, start with the first point of the Hilgenreiner line.

<p> </p>	<p>L: Define 1. of 2 points R: Exit function M: Free</p>	<p>Hilgenreiner's line (e.g. ischial bone tangent)</p>
----------	------------------------------------------------------------------	------------------------------------------------------------

- L ●** To define the first point of the Hilgenreiner line, use the left mouse button.
- R** To exit the function, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

<p> </p>	<p>L: Define 2. of 2 points R: Back M: Free</p>	<p>Hilgenreiner's line (e.g. ischial bone tangent)</p>
----------	---------------------------------------------------------	------------------------------------------------------------

- L ●** To define the second point of the Hilgenreiner line, use the left mouse button.
- R** To return to the first point, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

<p> </p>	<p>L: Pathologic side R: Exit function M: Free</p>	<p>Leg length correction</p>
----------	------------------------------------------------------------	------------------------------

- L ●** To define the reference point on the pathological femur, use the left mouse button.
- R** To exit the function, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

<p> </p>	<p>L: Nonpathologic side R: Back M: Free</p>	<p>Leg length correction Leg length difference: 79.0 mm</p>
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- L ●** To define the reference point on the **non** pathological femur (while moving the mouse cursor the Orthopaedic Application shows the leg length difference), use the left mouse button.

After you have positioned the second reference point, the outline is automatically moved to the corrected position, which is calculated corresponding to the leg length difference.

Step 7 Define hip joint center (HJC)

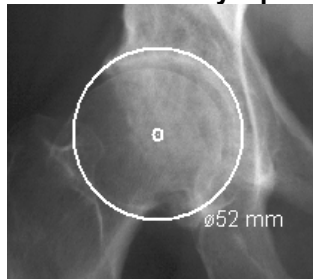
7

- Define hip joint center
- Circle by 3 points
 - CCD-angle
 - Free

Requirement: A scaled image
 To define a HJC you choose from:

- Circle by three points
- CCD angle
- Define free of your choice.

The method **Circle by 3 points** is described first:



Result: A circle is drawn by three points, the circle and the diameter in mm temporary appears, the center point of the circle is defined and drawn.

You are in the function **Circle by 3 points** (HJC). After you select the kind, color, and size of the line, start drawing the circle.

	L: 1. Point R: Exit function M: Free	HJC by 3 points
--	--------------------------------------------	-----------------

- L** • To define the first point on the femoral head or on the acetabulum convexity, use the left mouse button.
- R** To exit the function, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

	L: 2. Point R: Back M: Free	HJC by 3 points
--	-----------------------------------	-----------------

- L** • To define the second point on the femoral head or on the acetabulum convexity, use the left mouse button.
- R** To return to the first point, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

	L: 3. Point R: Back M: Free	HJC by 3 points
--	-----------------------------------	-----------------

- L** • To define the third point on the femoral head or on the acetabulum convexity, use the left mouse button.
- R** To return to the first point, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The hip joint center is drawn.

Define hip joint center

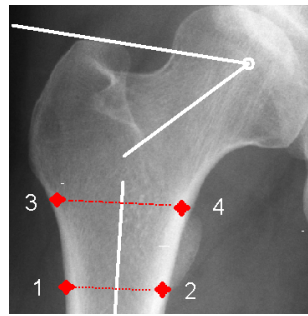
- Circle by 3 points

- CCD-angle

Free

Requirements: A scaled image

Result: With the function FSA (femur shaft axis) by four points the CCD angle ($84^\circ/130^\circ$) is drawn and the HJC (hip joint center) is defined.



L: Define 1. of 4 points
R: Exit function
M: Free

FSA by 4 points

L ● To define point 1 (for example, the distal, lateral inner corticalis), use the left mouse button.

R To go one step back, use the right mouse button.

M Define the position of the point **Free** of your choice.



L: Define 2. of 4 points
R: Back
M: Free

FSA by 4 points

L ● To define the point 2, which has to be opposite point 1, use the left mouse button.

R To return to point 1, use the right mouse button.

M Define the position of the point **Free** of your choice.



L: Define 3. of 4 points
R: Back
M: Free

FSA by 4 points

L ● To define point 3 (for example, the proximal, lateral inner corticalis), use the left mouse button.

R To return to point 2, use the right mouse button.

M Define the position of the point **Free** of your choice.



L: Define 4. of 4 points
R: Back
M: Free

FSA by 4 points

L ● To define the point 4, which has to be opposite point 3, use the left mouse button.

R To return to point 3, use the right mouse button.

M Define the position of the point **Free** of your choice.

The femoral shaft axis is displayed. One line intersecting the femoral shaft axis in an angle of 84° and a second line intersecting the femoral shaft axis in an angle of 130° is attached to the mouse pointer.



L: Place hip joint center
R: Exit function
M: Free

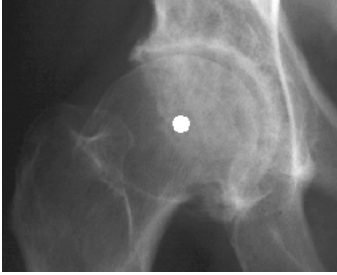



HJC (84.0° / FNA 130.0°)

L ● Move the mouse pointer the way that one line touches the tip of the trochanter major and the other line goes symmetrical through the femoral neck. The mouse pointer indicates now the hip joint center.

R To exit the function, use the right mouse button. The FSA remains drawn.

M Define the position of the point **Free** of your choice.

The hip joint center, the femoral shaft axis, and the lines indicating the CCD angle are displayed.

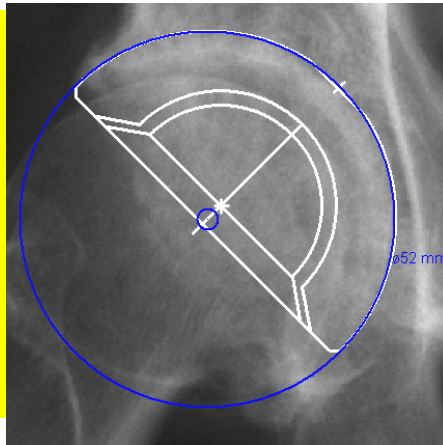
<p><i>Define hip joint center</i></p> <ul style="list-style-type: none"> - Circle by 3 points - CCD-angle - Free 	<p>Requirements: A scaled image Result: Using this function, define the position of the HJC (hip joint center) Free of your own choice</p> 	<p>7b</p>			
<p>After you select the kind, color, and size of the point, define the position of the HJC of your own choice.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30px; text-align: center;">  </td> <td style="padding: 2px;"> L: Place R: Exit function M: Free </td> <td style="text-align: right; padding: 2px;">HJC free</td> </tr> </table> <p> L ● To define the position of the point, use the left mouse button. R To exit the function, use the right mouse button. M Define the position of the point Free of your choice. </p> <p>The hip joint center is displayed.</p>				L: Place R: Exit function M: Free	HJC free
	L: Place R: Exit function M: Free	HJC free			

Step 8 Select cup **8**

- Insert cup
- Insert shaft
- Select length of head

Requirement: A scaled image and if necessary the hip joint center (HJC)
Result: Using this function, select the manufacturer, type, and size of a cup. Insert the cup at the required position and with the correct inclination

WARNING:
 All dimensions and measurements given by the Orthopaedic Application prostheses database derive from original manufacturers data or templates. An exemption from liability exists for incorrect or false original prostheses manufacturer data.



After you select the **Insert cup** function, you must have the last selected type of prostheses at the mouse pointer. After you selected the color (the line under the right side), select the prostheses to define the manufacturer:

- Kind of prostheses
- Type
- Size

The type attached to the mouse pointer always displays the actual selected prostheses.

	L: Drag and drop macro R: Reject macro M: Free	Macro tool
--	------------------------------------------------------	------------

- L** ● To position the prostheses **temporary**, use the left mouse button. In general, the prostheses appears with an inclination of 45°. With the keys ← →, change the inclination. The amount of the angle you change is displayed as **Angle** in the **Macro tool**.
- Note:** If the prostheses in not **finally** positioned, you can change all attributes using all pull-down menus of the Macro tool. The type and size can also be changed by the ↓↑ keys.
- L** ● To take and position the prostheses any time again, use the left mouse button.
- R** To finally position the prostheses and return to the **Hip-Endoprosthesis** menu, use the right mouse button.
- M** Define the position of the point **Free** of your choice.
 To snap to the hip joint center, press the **p** key and activate the snap-to-point mode of the mouse cursor.

The prostheses is positioned.
 To move or delete the prostheses, refer to **Often used functions**.

Step 9 Insert prostheses **9**

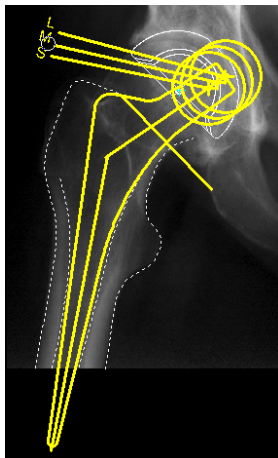
Insert cup
Insert shaft
 Select length of head
 Resection

Requirements: Scaled image, if necessary hip joint center, cup, drawn femoral outline

Result: Using this function, select the manufacturer, type, and size of a stem. Insert the stem at the required position and with the correct inclination.

Insert the stem at first overlapping into the inner corticalis of the drawn outline and place the resection line at the right position.

WARNING:
 All dimensions and measurements given by the Orthopaedic Application prostheses database derive from original manufacturers data or templates. An exemption from liability exists for incorrect or false original prostheses manufacturer data.



Note: To position the stem correctly the first time on the hip joint center is difficult. *For more information on **Reposition the Stem** refer to Step 12.*

After you select the function, you must have the last selected type of prostheses at the mouse pointer. After you select the color (the line under the right side), select the prostheses to define the manufacturer:

- Kind of prostheses
- Type
- Size

The type attached to the mouse pointer always displays the actually selected prostheses.



L: Drag and drop macro
 R: Reject macro
 M: Free

Macro tool

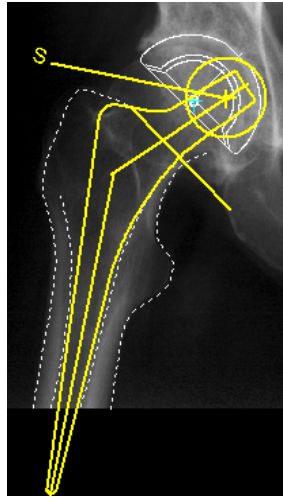
- L** ● To **temporarily** position the prostheses, use the left mouse button. With the keys ← →, change the inclination. The amount of the angle you changed is displayed as **Angle** in the **Macro tool**.
Note: If the prostheses in not **finally** positioned, you can change all attributes using all pull-down menus of the Macro tool. The type and size can be also changed by the ↑↓ keys.
- L** ● To take and position the prostheses again, use the left mouse button.
- R** To finally position the prostheses and return to the **Hip-Endoprotheses** menu, use the right mouse button.
- M** Define the position of the point **Free** of your choice.
 To snap to the hip joint center press the **p** key and activate the snap-to-point mode of the mouse cursor.

The prostheses is positioned except the neck.
 To move or delete the prostheses, refer to **Often used functions**.

Step 10 Select neck length **10**

Select necklength

Requirements: Correct position of the stem except the neck
Result: The neck length also affects the postoperative leg length and the lateral or medial changed position.
 You are in the function **Show/Hide stem/neck**.



L: Select size
 R: Exit function
 M: Element or Line

Show/Hide stem/head/...

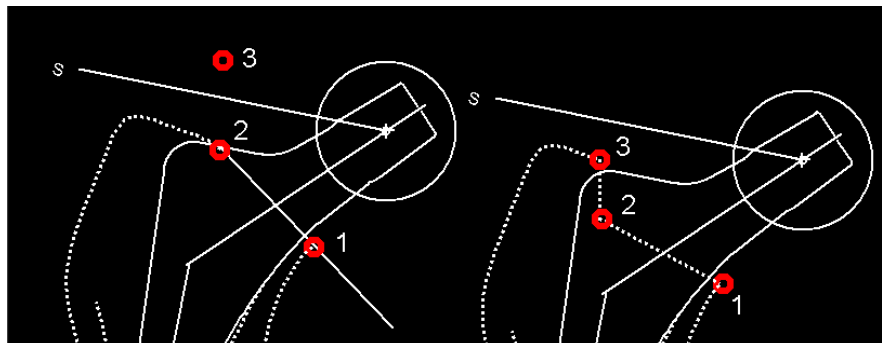
- L** ● To select the desired neck length, use the left mouse button. You can select the displayed length, for example, L/S/M or the line indicating the center or the choose one center point of the neck.
- L** ● To change the selection, use the left mouse button.
- R** To exit the function and return to the **Module Hip Endoprostheses**, use the right mouse button.
- M** Using this mode, the snap-to mode for Element/Line is activated.

Step 11 Draw resection line **11**

Select length of head
Resection
 Reposition of shaft/prost...
 Measure GP treatment data

Requirements: The prostheses is correctly inserted into the femur shaft

Result: Corresponding to the resection line, the outer and inner corticalis is reselected and the hip head is faded out. You can draw the resection line as a straight line or as a line with a step. Both a line with three points is needed. You are in the function **Resect**.



L: Define 1. of 3 points
 R: Exit function
 M: Free

Resect

- L** ● To define the first point, the medial starting point of the resection line, use the left mouse button.
- R** To exit the function and return to the **Module Endoprostheses**, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

L: Define 2. of 3 points
 R: Back
 M: Free

Resect

- L** ● To define the second point, use the left mouse button. For a straight resection, the second point is on the lateral corticalis. For a line with a step, it indicates the step (refer to the picture above).
- R** To return to point 1, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

L: Define 3. of 3 points
 R: Back
 M: Free

Resect

- L** ● To define the third point, use the left mouse button. For a straight resection, this point is outside the femoral outline. For a line with a step, it is placed on the outer corticalis (refer to the picture above).
- R** To return to point 2, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The resection line and the length in mm are displayed.

Step 12 Reposition of shaft/prostheses **12**

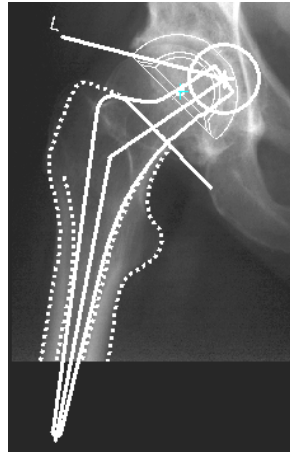
Select length of head

Resection

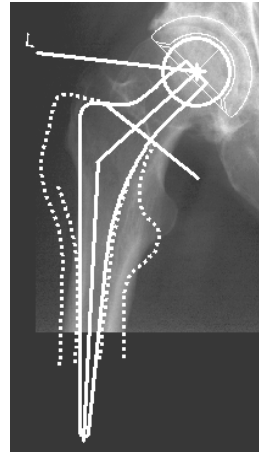
Reposition of shaft/prost...

Requirements: Cup and stem are inserted

Result: The center point of the stem (neck) and the center point of the cup are identical. If required, correct abduction and adduction at the same time with the function Copy/ Move tool. The function Move is activated.



Before



after reposition

	L: Select element or define first corner of area R: Finish selection M: Element or Line	Move
--	-----------------------------------------------------------------------------------------------	------

- L** ● To select additional single elements to move if required, use the left mouse button. You can also select elements by using the mouse to drag open a box covering a required image section including all elements to move. Automatically preselected are:
 - first element is the stem
 - second element is the drawn shaft outline
- R** ● To finish the selection, use the right mouse button.
NOTE: Do not forget this mouse click to finish the selection.
- M** The snap-to Element/Line mode is activated.

	L: Grab point R: Exit function M: Point	Move
--	-----------------------------------------------	------

- L** ● To choose the center point of the stem, use the left mouse button. (neck)
- R** To return to the **Module tool**, use the right mouse button.
- M** Snap-to-point mode is activated.

The femoral outline along with the stem is attached to the mouse.

To **move** drag the mouse, to **rotate** press the keys ←→.

	L: Destination point R: Back M: Point	Move
--	---------------------------------------------	------

- L** ● To choose the center point of the cup as destination point, use the left mouse button.
- R** To return to the **Copy/move tool**, use the right mouse button.
- M** Snap-to-point mode is activated.

The prostheses geometry is repositioned.

All facts of **Patient/Physician** and the **Implants** are automatically inserted in the **Planning informations** and are saved along with the graphic of your planning. If you change the templates, all **Planning informations** are automatically updated.

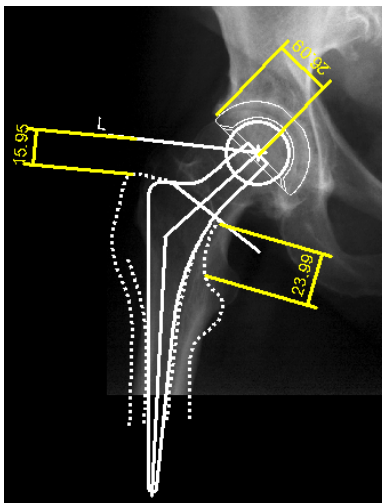
Step 13a Define dimensions in mm

13
a

Measure of relevant data

- Measure angles
- Measure distances

Requirements: A new hip geometry is inserted
Result: Measurements of length are drawn and applicable to be used intraoperative.
 The function **Dimension tool** is activated.
 Below you see several real life examples for dimensions.



	L: 1. Point R: Cancel M: Free	Dimension parallel
--	-------------------------------------	--------------------

- L** ● To choose the first point of the distance to be measured, use the left mouse button.
- R** To return to the **Module tool**, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

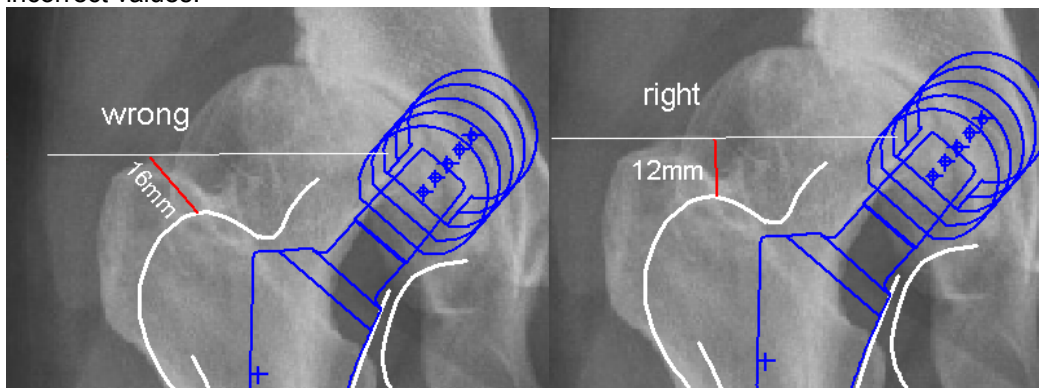
	L: 2. Point R: Back M: Free	Dimension parallel Length: 341.8 mm
--	-----------------------------------	----------------------------------------

- L** ● To choose the second point of the distance to be measured, use the left mouse button.
- R** To return to the first point, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

If you have not defined the second point, the distance is already displayed in the **Information bar**.

The information changes by moving the mouse cursor on the screen.

NOTE: To measure the leg length difference, take points which are perpendicular to each other. An inclination of the displayed line between the measurement points sometimes indicates incorrect values.



Step 13b Define angles in degree

13
b

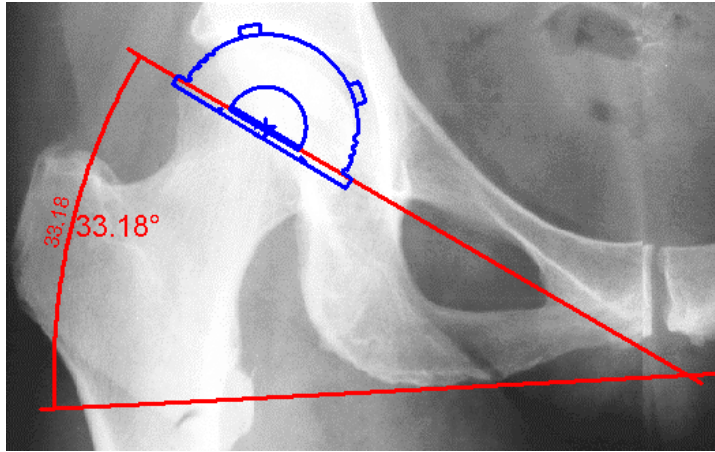
~~Measure of Element data~~

- Measure angles
- Measure distances

Requirements: A new hip geometry is inserted
Result: Angles are drawn and applicable to be used intraoperative.

The function **Dimension tool** is activated.

Below you see an example for the measurement of an angle:



You are in the **Dimension tool**.

	L: Select 1. line R: Exit function M: Element or Line	Dimension angle
--	-------------------------------------------------------------	-----------------

L ● To choose the first side of the angle, use the left mouse button.
NOTE: The measurement of an angle is counter clockwise.

R To return to the Module tool, use the right mouse button.

M The snap to element mode is preselected.

	L: Select 2. line R: Back M: Element or Line	Dimension angle
--	----------------------------------------------------	-----------------

L ● To choose the second side of the angle, use the left mouse button.

R To return to the first side of the angle, use the right mouse button.

M The snap-to element mode is preselected.

The dimension of the angle is attached to the mouse pointer.

	L: Place dimension text R: Back M: Free	Dimension angle
--	-----------------------------------------------	-----------------

L ● To place the dimension at the desired position, use the left mouse button.

R To return to the first side of the angle, use the right mouse button.

M The snap to element mode is preselected.

The dimension in degree is shown.

Hip Endoprostheses/Biometry

Basics

The positioning of the prosthesis within the skeletal-muscular system influences the biomechanical forces acting when the joint is under static load and also when the joint is moving.

Shortened or stretched muscle fascicles indicate a joint deformity and allow conclusions to be drawn as to the pressure present inside a joint.

If extensive joint deformities are present, for example, coxarthrosis as a result of dysplasia of the hip or posttraumatic arthrosis, it is difficult when fixing the implants to achieve biomechanical ideal implant geometry and implant stability at the same time.

The Biometry module enables you to plan hip prostheses with optimum joint geometry comparable to that of a healthy joint:

- To assess the joint situation, geometrical force parameters acting on the hip are compared with the normal values found in healthy probands.
- The postoperative joint situation is evaluated for several potential centers of rotation of the prosthesis. This enables you to quickly find the optimum center of rotation for the prosthesis and to ensure the best surgical outcome for your patient.

Images

A successful biometric analysis can only be obtained if the following criteria have been met when taking the x-ray used for planning:

- Symmetrical positioning of the pelvis
- Hip joint in neutral position
- Longitudinal axis of the femur parallel to the image receptor plane
- Patella in zero position
- Central ray six inches above the symphysis
- Lead sphere of known size or scale bar at the level of the femur shaft as a calibration aid

CAUTION:

The criteria described above must be met to ensure that the optimum rotation center of the endoprosthesis is accurately determined.

Marker points

The Orthopaedic Application uses 10 defined points, which you mark on the image to determine the direction of the pulling force of the individual muscles and to draw conclusions as to their direction of action.

Biomechanical parameters

Six biomechanical hip parameters are determined. Each parameter is compared with the normal values found in healthy probands and is evaluated with the aid of a scientifically-based matrix that has been tried and tested in clinical practice.

Hip score

The total of all values determined in this way makes up what is known as the hip score or BLB score (after Babisch-Layher-Blumentritt). The BLB score is therefore a value by means of which the overall joint situation can be assessed.

Optimum rotation center

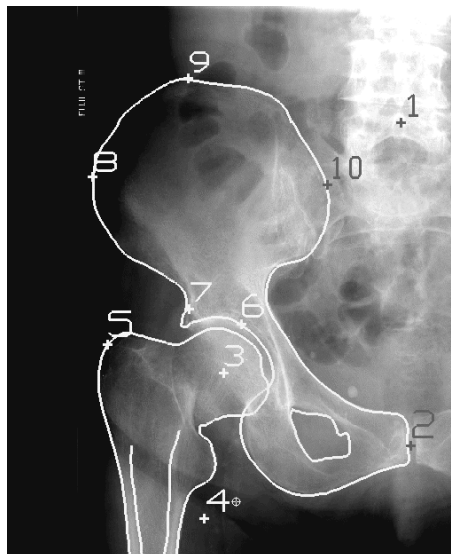
To determine the optimum postoperative rotation center of the prosthesis, the joint situation is evaluated to locate many potential rotation centers. The possible rotation centers are displayed on the image as simulation points.

Biometric Marker points (overview)

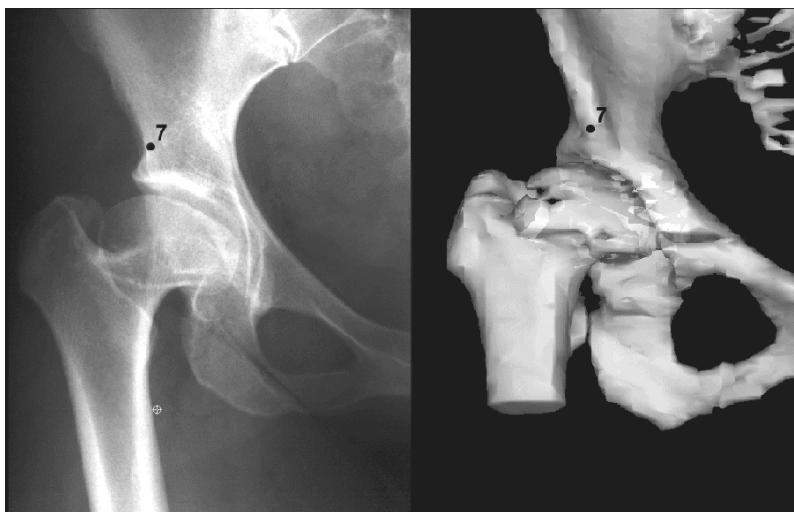
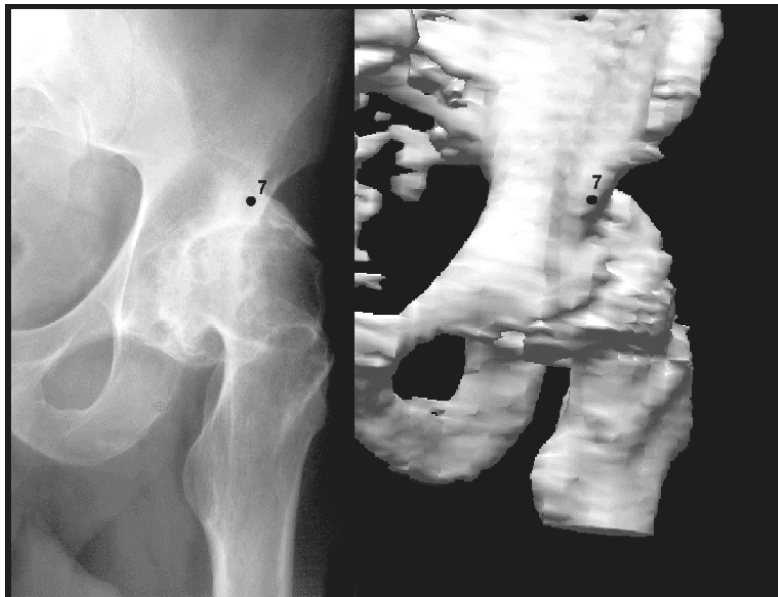
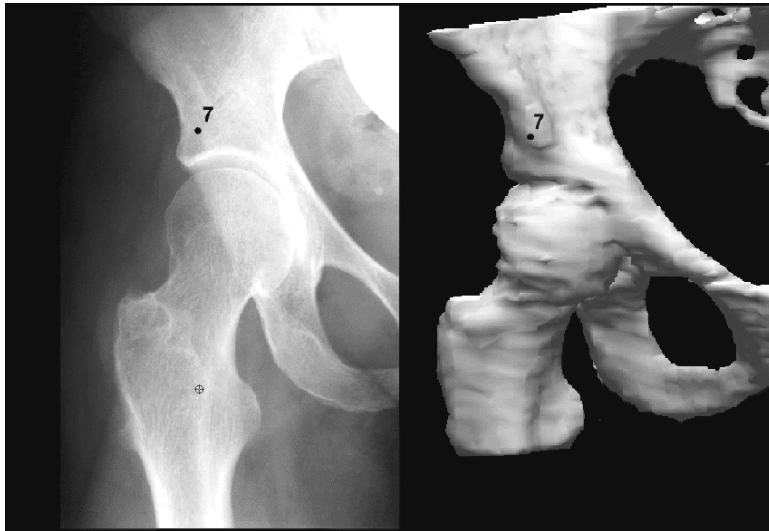
The ten marker points are derived from the model by Blumentritt (Blumentritt S.: Biomechanische Bauprinzipien des menschlichen Hüftgelenkes in der Frontalebene. [Biomechanical Structural Principles of the Human Hip Joint in the Frontal Plane.] Gegenbaurs morphol. annual 134 (1988) 221-240)

Point 1	Upper middle part of processus spinosus L5 (Base of os sacrum)
Point 2	Lower mid-symphysis
Point 3	Pre-operative rotation center (hip joint center)
Point 4	ca. 3cm distal lesser trochanter minor (in the imagined direction of pull of the rectus femoris muscle towards the medial upper edge of the patella)
Point 5	Lateral, most proximal edge of the trochanter major
Point 6	Most cranial edge of the sclerotic area.
Point 7	Spine iliaca anterior inferior If coxarthrosis as a result of dysplasia is present: point of sclerotic area more or less midway between the outer and inner edge of acetabulum
Point 8	Most lateral point of the wing of the ilium
Point 9	Most cranial point of the wing of the ilium
Point 10	Most medial point of the wing of the ilium

Note: For the calculation of the biometric values, we suggest making an image with the total wings of ilium and a femoral shaft as long as possible



Point 7 in differently formed hip joints:



Biomechanical parameters (overview)

Angles

BETADIFF

Deviation of calculated direction of pull of the abductor muscles from their ideal direction of action.

SZWITH

Theoretical direction of the resulting joint counterforce in relation to the horizontal (position of the sclerotic area).

KLDELTAOPT

Direction of pull of the rectus femoris muscle in relation to the horizontal in an ideal joint situation.

Length ratios

VRECABD

Ratio of lever lengths (vertical distance of directions of pull from the rotation center) of the rectus femoris and the abductor muscles.

VD5ABD

Ratio of lever lengths (vertical distance of directions of pull from the rotation center) of the center of gravity of part of the body and the abductor muscles.

Force parameters

RREL

Resulting joint counterforce relative to body weight.

Assessment values / hip score

The biomechanical parameters are compared to the values found in healthy probands and evaluated as follows:

Assessment value

2
1
0

Evaluation

Normal range MW: $- 2 SD \leq x \leq MW + 2 SD$
Critical range: MW: $- 3 SD \leq x \leq MW + 3 SD$
outside twice the standard deviation:
 $x < MW \pm 3 SD < x$
MW =mean; SD = standard deviation

Hip score

10–12
7–9
4–6
0–3


Evaluation

ideal, such as good or very good hip biomechanics
satisfactory hip biomechanics
moderate, unfavorable hip biomechanics
poor hip biomechanics

The greater the hip score

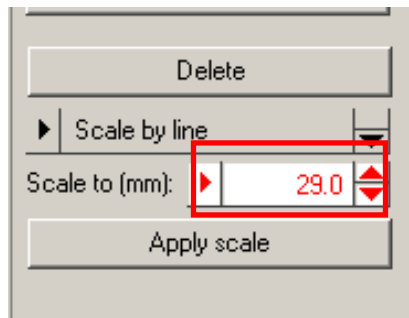
- The better the biomechanics
- The longer the life span of the prosthesis
- The less postoperative pain
- The better the gait pattern
- The better the Harris hip score

Procedure

 <p>Select the image and scale it.</p>	<p>Step 1 Image selection 1</p>																											
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30px; text-align: center;"></td> <td style="width: 400px;">L: Select image to move or to scale</td> <td style="width: 300px; text-align: right;">T:\mediCAD\bilder\perthes\Bild17.bmp</td> </tr> <tr> <td style="text-align: center;"></td> <td>R: Exit function</td> <td></td> </tr> <tr> <td style="text-align: center;"></td> <td>M: Element or Line</td> <td></td> </tr> </table> <p>L ● To take the image and position it, use the left mouse button.</p> <p>R To exit the function, use the right mouse button.</p> <p>M Not relevant</p>		L: Select image to move or to scale	T:\mediCAD\bilder\perthes\Bild17.bmp		R: Exit function			M: Element or Line																				
	L: Select image to move or to scale	T:\mediCAD\bilder\perthes\Bild17.bmp																										
	R: Exit function																											
	M: Element or Line																											
<div style="display: flex; justify-content: space-between;"> <div data-bbox="207 548 558 751" style="border: 1px solid gray; padding: 5px; width: 20%;"> <p>Scale by line</p> <p>Scale by circle</p> </div> <div data-bbox="581 594 1258 804"> <p>Select the scale mode and scale the image with the reference, which is visible on the screen.</p> <p>With the aid of a distance line when a scale bar is visible.</p> <p>With the aid of a circle when a scaling sphere is visible on the screen.</p> </div> </div> <div style="text-align: right; margin-top: 10px;"> <p>Step 2 Select scale mode 2</p> </div> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <tr> <td style="width: 30px; text-align: center;"></td> <td style="width: 400px;">L: 1. Point</td> <td style="width: 300px; text-align: right;">T:\mediCAD\bilder\perthes\Bild17.bmp</td> </tr> <tr> <td style="text-align: center;"></td> <td>R: Cancel scaling</td> <td></td> </tr> <tr> <td style="text-align: center;"></td> <td>M: Free</td> <td></td> </tr> </table> <p>L ● To define the first point of a line or the edge of a circle, use the left mouse button.</p> <p>R To exit the function, use the right mouse button.</p> <p>M Define the position of the point Free of your choice.</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <td style="width: 30px; text-align: center;"></td> <td style="width: 400px;">L: 2. Point</td> <td style="width: 300px;"></td> </tr> <tr> <td style="text-align: center;"></td> <td>R: Back</td> <td></td> </tr> <tr> <td style="text-align: center;"></td> <td>M: Free</td> <td></td> </tr> </table> <p>L ● To define the second point of a line or a the edge of a circle, use the left mouse button.</p> <p>R To return to the first point, use the right-mouse button.</p> <p>M Define the position of the point Free of your choice.</p> <p>If you scaled with the aid of a line, scaling now is done. If you scaled with the aid of a circle complete, the circle with the third point.</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <td style="width: 30px; text-align: center;"></td> <td style="width: 400px;">L: 3. Point</td> <td style="width: 300px; text-align: right;">T:\mediCAD\bilder\</td> </tr> <tr> <td style="text-align: center;"></td> <td>R: Back</td> <td></td> </tr> <tr> <td style="text-align: center;"></td> <td>M: Free</td> <td></td> </tr> </table> <p>L ● To define the third point of the edge of a circle, use the left mouse button.</p> <p>R To return to the first point, use the right mouse button.</p> <p>M Define the position of the point Free of your choice.</p>		L: 1. Point	T:\mediCAD\bilder\perthes\Bild17.bmp		R: Cancel scaling			M: Free			L: 2. Point			R: Back			M: Free			L: 3. Point	T:\mediCAD\bilder\		R: Back			M: Free		
	L: 1. Point	T:\mediCAD\bilder\perthes\Bild17.bmp																										
	R: Cancel scaling																											
	M: Free																											
	L: 2. Point																											
	R: Back																											
	M: Free																											
	L: 3. Point	T:\mediCAD\bilder\																										
	R: Back																											
	M: Free																											

Step 3 Scaling measurement in mm **3**

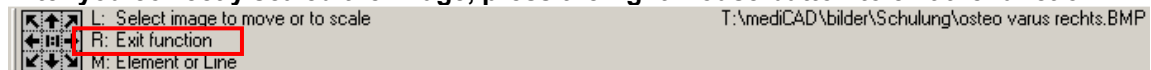
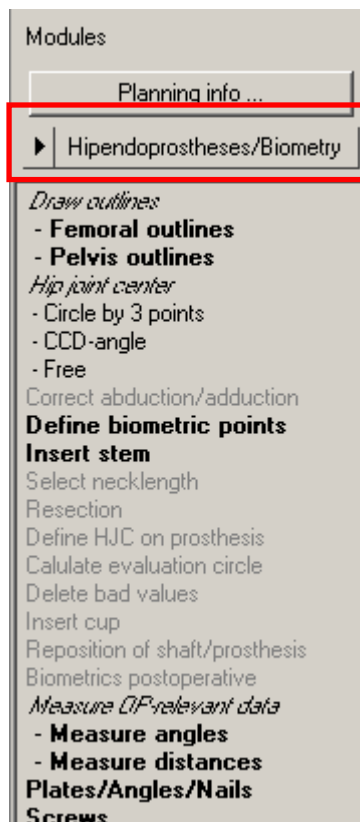
Fill in the correct measurement of the reference and confirm with **Apply scale** or **Enter**.



Warning: You can only scale the image correctly if a scale bar or a scaling sphere was placed in the image area while the image was exposed. Check your measurements carefully. False values can have serious consequences for the patient regarding misinterpretations of the right prostheses size.

Note:

After you correctly scaled the image, press the right mouse button to exit the function

Step 4 Select module **4**

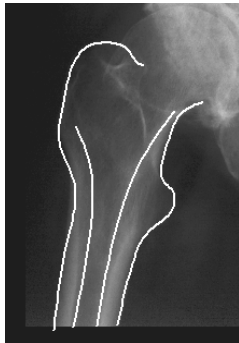
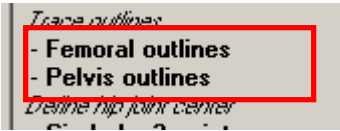
Choose the required module to work with.

The **Module Biometry** is activated. You can exit this module at any time to select another module.

By activating the next steps of the menu, you automatically get into the right function tool and are guided by the **Information bar**.

The support given by the **Information bar** is described next.

Step 5 Draw contours **5**



Requirement: A scaled image
Result: The femur outline or the pelvis outline is drawn by clicking on several intermediate points on the bone outline.

You are in the **Contour tool**.

Drawing the bone outline offers you the following advantages:

- The bone outlines are highlighted, making it easier for you to insert the prostheses in the image.
- By moving and rotating the outlines you can visualize the intended postoperative joint situation in the image.
- The femur outline are four lines.
- You draw along each outline individually. Afterwards the outlines are automatically combined to form a “femur outline” object.

After you select the kind, color, and size of the line, click one point after the other, following the contour. The spline function requires less intermediate points for straight lines than for curves.

Note: To reject points go to the **Reject points** function or press the **backspace** key (above return). You reject the points step-by-step and continue drawing.

		L: first point R: Cancel M: Free	Contours
L	•	To define the first point of the femur outline, use the left mouse button. For example, you start drawing the lateral outer corticalis.	
R		To exit the function, use the right mouse button.	
M		Define the position of the point Free of your choice.	
		L: next point R: next contour M: Free	Contours Press backspace to reject the last point

- L** • To define the next point of the outline, use the left mouse button.
- R** To finish the line and start the next, use the right mouse button. For example, the lateral inner corticalis
- M** Define the position of the point **Free** of your choice.

You draw the medial/lateral inner and outer corticalis in the same way.

- R** • With the first mouse click you finish the line.
- R** • With the second mouse click on the image you exit the function.

NOTE: If you forgot one outline or you delete one to draw it once more, go to the **Femoral outlines** function, select the **Group by** → **femur outline ap** function, and repeat drawing as described above.

To draw a pelvis outline, do the same drawing with the function **Pelvis outlines**.

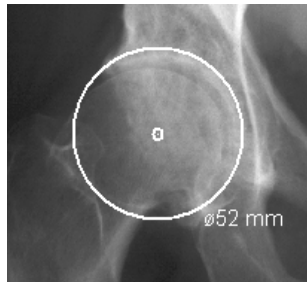
After you exit the function, you return to the **Module tool** and choose the next dimmed written function.

NOTE: You do not need to make a leg length correction at this point. The leg length correction is done and displayed automatically by the module later on.

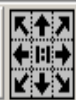
Step 6 Define hip joint center (HJC) **6**

Define hip joint center

- Circle by 3 points
- CCD-angle
- Free

Requirement: A scaled image**Result:** A circle is drawn by three points, the circle and the diameter in mm temporary appears, the center point of the circle is defined and drawn.

You are in the function **Circle by 3 points (HJC)**. After you select the kind, color, and size of the line, start drawing the circle.



L: 1. Point

R: Exit function

M: Free

HJC by 3 points

L ●

To define the first point on the femoral head or on the acetabulum convexity, use the left mouse button.

R

To exit the function, use the right mouse button.

MDefine the position of the point **Free** of your choice.

L: 2. Point

R: Back

M: Free

HJC by 3 points

L ●

To define the second point on the femoral head or on the acetabulum convexity, use the left mouse button.

R

To return to the first point, use the right mouse button.

MDefine the position of the point **Free** of your choice.

L: 3. Point

R: Back

M: Free

HJC by 3 points

L ●

To define the third point on the femoral head or on the acetabulum convexity, use the left mouse button.

R

To return to the first point, use the right mouse button.

MDefine the position of the point **Free** of your choice.

The hip joint center is drawn.

To define the hip joint center by the **CCD angle** or **Free**, refer to the description under **Hip Endoprostheses** → **procedure** steps 7a and 7b.

Step 7 Correct abduction/adduction **7**

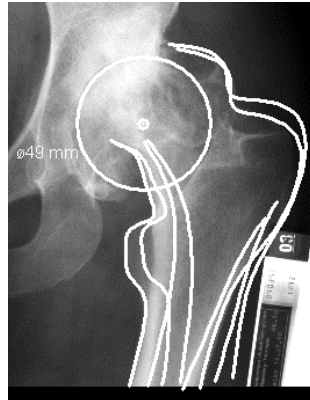
NOTE: To achieve an optimized joint geometry, we recommend correcting the adduction/abduction now to review the selection of the stem much better. The rotation of the femoral outline is described next.

Correct abduction/adduction
Define biometric points
 Insert stem

Requirement: Femoral outline is drawn.

Result: The position of the femoral shaft axis is parallel to the non-pathologic femur axis.

You are in the **Copy/move tool**.



L: Select element or define first corner of area
 R: Finish selection
 M: Element or Line Move

- L** ● To select more elements if needed, use the left mouse button. The femoral outline is preselected.
- R** ● To finish the selection, use the left mouse button.
NOTE: Do not forget this mouse click to complete the selection.
- M** The snap to Element/Line mode is activated.

L: Grab point
 R: Exit function
 M: Point Move

- L** ● To choose the hip joint center point, use the left mouse button.
- R** To return to the **Module tool**, use the right mouse button.
- M** Snap-to-point mode is activated.

The femoral outline is attached to the mouse.
 To **move** drag the mouse.

To **rotate** press the ← → keys.

L: Destination point
 R: Back
 M: Point Move

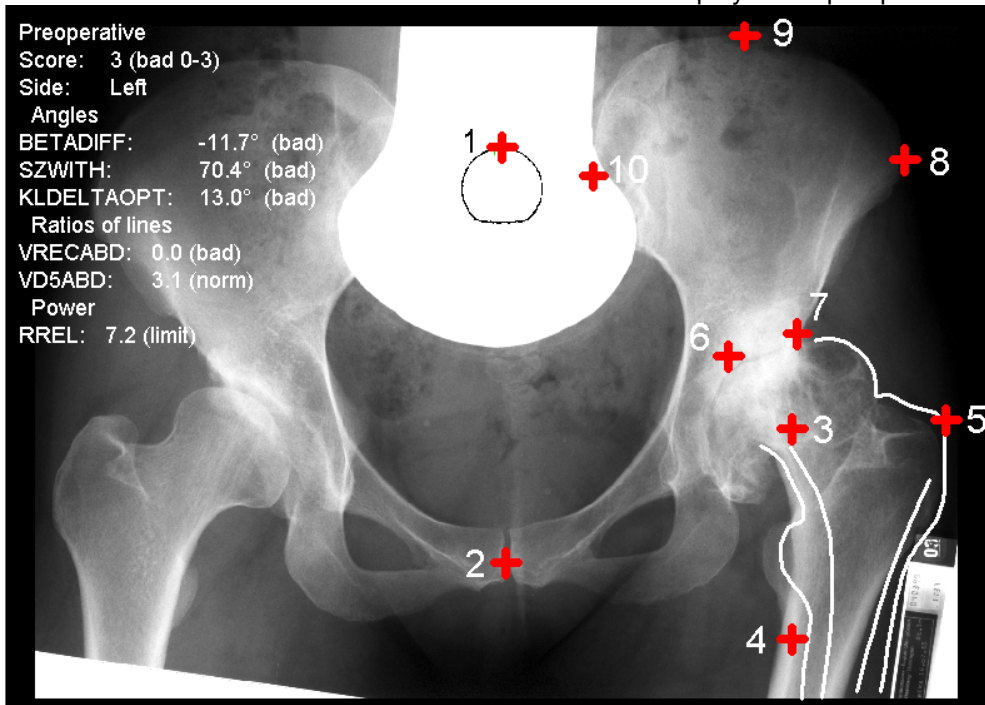
- L** ● To choose the hip joint center point again as destination point, use the left mouse button.
- R** To return to the **Copy/move tool**, use the right mouse button.
- M** Snap-to-point mode is activated.

The femur outline is repositioned.

Step 8 Define biometrical points **8****Requirements:**

1. Pelvis overview with iliac crest and sufficient femur shaft length
2. **Caution:** You must correctly input the height and weight of the patient (into **Planning information**). Without this information, the definition of 10 biometrical points is not possible.

Result: Calculation and display of the preoperative values.



Preoperative
 Score: 3 (bad 0-3)
 Side: Left
 Angles
 BETADIFF: -11.7° (bad)
 SZWITH: 70.4° (bad)
 KLDELTAOPT: 13.0° (bad)
 Ratios of lines
 VRECABD: 0.0 (bad)
 VD5ABD: 3.1 (norm)
 Power
 RREL: 7.2 (limit)

Define reference points and calculate preop biome
 L: Cranial body centre
 R: Cancel
 M: Free

L ● To define the first point, the upper central part of processus spinosus L5 (Base of os sacrum), use the left mouse button.

R To return to the **Module tool**, use the right mouse button.

M Define the position of the point **Free** of your choice.

Define reference points and calculate preop biometrics
 L: Kaudal body centre
 R: Back
 M: Free

L ● To define the second point, the lower mid-symphysis, use the left mouse button.

R To return to point 1, use the right mouse button.

M Define the position of the point **Free** of your choice.

Define reference points and calculate preop biometri
 L: Centre of hipjoint (preop.)
 R: Back
 M: Free

L ● To define the third point the hip head center point/preoperative rotation center (HJC), use the left mouse button.







R To return to point 2, use the right mouse button.

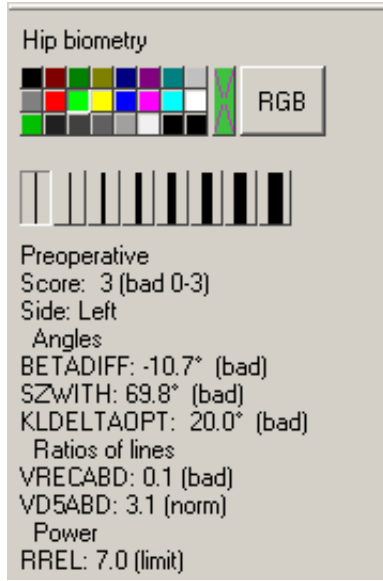
M Define the position of the point **Free** of your choice.

Define reference points and calculate preop biometri
 L: Power direction of M. rectus femoris
 R: Cancel
 M: Free

L ● To define the fourth point, ca. 2cm distal lesser trochanter minor (in the imagined direction of pull of the rectus femoris muscle towards the medial upper edge of the patella), use the left mouse button.

R To return to point 3, use the right mouse button.

<p>M Define the position of the point Free of your choice.</p>	
	<p>L: Greater trochanter R: Back M: Free</p> <p>Define reference points and calculate preop biometri</p>
<p>L ●</p>	<p>To define the fifth point, the lateral, most proximal edge of the trochanter major, use the left mouse button.</p>
<p>R</p>	<p>To return to point 4, use the right mouse button.</p>
<p>M</p>	<p>Define the position of the point Free of your choice.</p>
<p> L: Kaudal wing of ilium R: Back M: Free</p> <p>Define reference points and calculate preop biometri</p>	
<p>L ●</p>	<p>To define the sixth point, the most cranial edge of the sclerotic area, use the left mouse button.</p>
<p>R</p>	<p>To return to point 5, use the right mouse button.</p>
<p>M</p>	<p>Define the position of the point Free of your choice.</p>
<p> L: Spina iliaca anterior inferior R: Back M: Free</p> <p>Define reference points and calculate preop biometri</p>	
<p>L ●</p>	<p>To define the seventh point, the spina iliaca anterior inferior, use the left mouse button.</p> <p>NOTE: For more information refer to Biometric Marker Points (overview).</p>
<p>R</p>	<p>To return to point 6, use the right mouse button.</p>
<p>M</p>	<p>Define the position of the point Free of your choice.</p>
<p> L: Lateral wing of ilium R: Back M: Free</p> <p>Define reference points and calculate preop biometri</p>	
<p>L ●</p>	<p>To define the eighth point, the most lateral edge of the wing of the ilium, use the left mouse button.</p>
<p>R</p>	<p>To return to point 7, use the right mouse button.</p>
<p>M</p>	<p>Define the position of the point Free of your choice.</p>
<p> L: Canial wing of ilium R: Back M: Free</p> <p>Define reference points and calculate preop biometri</p>	
<p>L ●</p>	<p>To define the ninth point, the most cranial edge of the wing of the ilium, use the left mouse button.</p>
<p>R</p>	<p>To return to point 8, use the right mouse button.</p>
<p>M</p>	<p>Define the position of the point Free of your choice.</p>
<p> L: Medial wing of ilium R: Back M: Free</p> <p>Define reference points and calculate preop biometri</p>	
<p>L ●</p>	<p>To define the tenth point, the most medial edge of the wing of the ilium, use the left mouse button.</p>
<p>R</p>	<p>To return to point 9, use the right mouse button.</p>
<p>M</p>	<p>Define the position of the point Free of your choice.</p>
<p>At first the 10 preoperative biometrical points are defined. The calculated biometrical values are displayed in the Hip Biometry Tool.</p>	



The preoperative values are calculated and scored.

NOTE: For more information, refer to **Assessment values / hip score**.

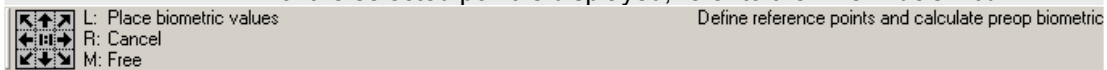
If necessary correct the position of one or more biometric points now

By changing the position of points you influence the biometric values. You recognize the changing immediately afterwards in the calculation.



L ● To correct the position of one or more biometric points now if necessary, use the left mouse button. Select one or more of the 10 points and move it to the next place. While moving control the result by looking at the values.

L ● To position the selected point, use the left mouse button. The name of the selected point is displayed, refer to the **Information bar**.



R ● To exit the function **Calculate values** and have the chart attached to the mouse cursor, use the right mouse button. Position it onto the screen. Later on you get the postoperative chart for comparison.

L ● To position the chart onto the screen, use the left mouse button.

M Define the position of the point **Free** of your choice.

Step 9 Insert stem

9

Define biometric points
Insert stem
 Select neck length
Resection

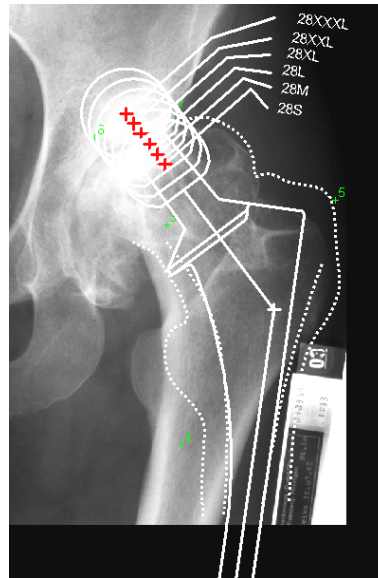
Requirements: A drawn femoral outline, 10 biometrical points are inserted
Result: With the function *Insert stem*, select the manufacturer, type, and size of a stem. At first insert the edge of the stem in that way it overlaps the inner corticalis and the resection line is in a correct position.

NOTE:

For the complete description of this Function, refer to *Often used functions* → *Insert a prosthesis*.

WARNING:

All dimensions and measurements given by the Orthopaedic Application prostheses database derive from original manufacturers data or templates. An exemption from liability exists for incorrect or false original prostheses manufacturer data.



You are in the *Macro tool*. After you select the kind, color and size of the prostheses, the at last selected type is attached to the mouse cursor. With the pull-down menus of the *Macro tool* you make your choice by selecting:

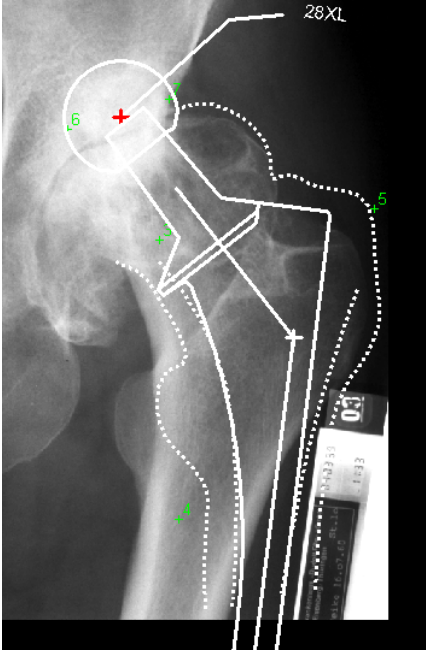












- Manufacturer
- Kind (cup/stem/ap or ml or revision)
- Type
- Size of head, stem, etc.

NOTE: Do not care about the rotation center of the head or the neck length of the stem. Both are handled within step 10 and 11.

	L: Drag and drop macro R: Reject macro M: Free	Macro tool
--	------------------------------------------------------	------------

- L** ● To position the prostheses **temporary** inside the inner corticalis of the contour of the stem, use the left mouse button.
 With the ←→ keys you can change the inclination. The amount of the angle you changed is displayed as **Angle** in the *Macro tool*.
Note: As long as the prostheses **temporary** positioned you can change all attributes using all pull-down menus of the *Macro tool* The type and the size can be also changed by the ↑↓ keys.
 The inclination angle can be changed by the ←→ keys.
- L** ● To take and position the prostheses any time again, use the left mouse button.
- R** To finally position the prostheses and return to the *Hip-Endoprosthesis* menu, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The prostheses is positioned except the neck.

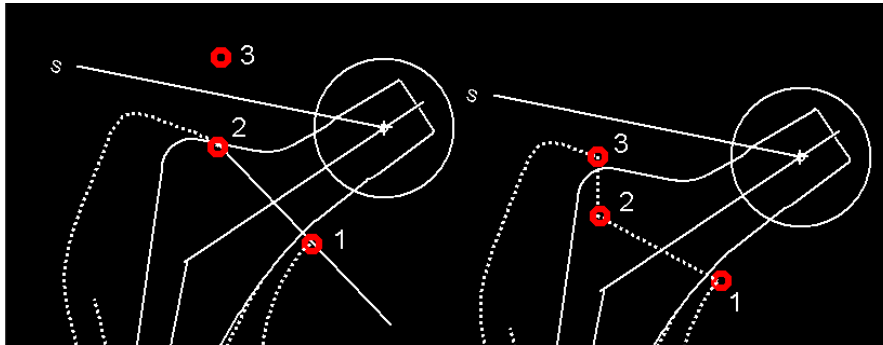
<p style="text-align: right;">Step 10 Select neck length</p> <div style="border: 1px solid red; padding: 2px; display: inline-block; margin-bottom: 10px;"> Select necklength Resection </div> <p>Requirement: The stem is positioned Result: The neck length determines the postoperative leg length as well as a chanded lateral position. You are in the function Show/hide stem/head.</p> 	10			
<div style="border: 1px solid gray; padding: 5px; margin-bottom: 10px;"> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30px; text-align: center;">     </td> <td style="padding-left: 5px;"> L: Select size R: Exit function M: Element or Line </td> <td style="text-align: right; padding-right: 5px;"> Show/Hide stem/head/.. </td> </tr> </table> </div> <ul style="list-style-type: none"> <li style="margin-bottom: 10px;">L ● To select the required neck length, use the left mouse button. Choose one of the displayed letters (L/S/M), the line pointing at the head center, or choose the head center itself. <li style="margin-bottom: 10px;">L ● Click again to correct your choice. <li style="margin-bottom: 10px;">R To exit the function and return to the Hip endoprostheses tool, use the right mouse button. M With this mode the snap-to mode for Element/Line is activated. 	   	L: Select size R: Exit function M: Element or Line	Show/Hide stem/head/..	
   	L: Select size R: Exit function M: Element or Line	Show/Hide stem/head/..		

Step 11 Draw resection line

11

Select length of head
Resection
~~Define HJC prostheses~~
 Calculate biometrics

Requirements: The stem outline is drawn and the prosthesis positioned
Result: The femoral outline is resected.
 The resection line can be drawn as a straight line or a line with one step. You need three points to draw the line.
 You are in the **Resection** function.



L: Define 1. of 3 points Resect
 R: Exit function
 M: Free

- L** ● To define the first point, use the left mouse button. It indicates the start of the resection upon the medial outer corticalis of the femoral outline.
- R** To exit the function and return to the **Hip Endoprostheses/Biometry tool**, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

L: Define 2. of 3 points Resect
 R: Back
 M: Free

- L** ● To define the second point, use the left mouse button. Drawing a straight line put this point on the lateral outer corticalis; otherwise, indicate the step (refer to the picture above).
- R** To return to point 1, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

L: Define 3. of 3 points Resect
 R: Back
 M: Free

- L** ● To define the third point, use the left mouse button. If drawing a straight line put this point somewhere outside the femoral outline, otherwise upon the lateral outer corticalis (refer to the picture above).
- R** To return to point 2, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The resection line and the dimensions in mm of the resection are displayed.

Step 12 define postoperative hip joint center (HJC)at the stem

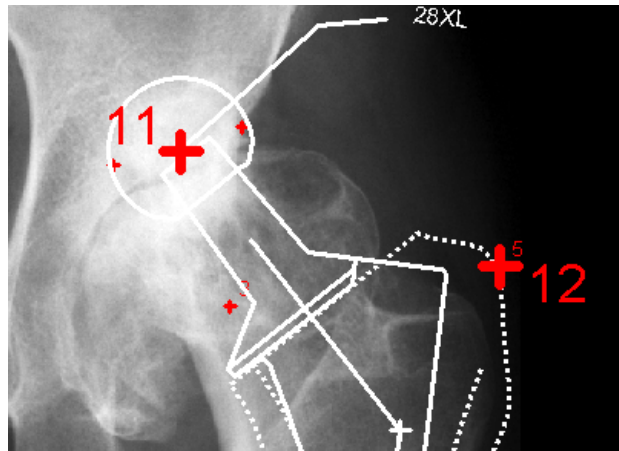
12

Resection

Define HJC-prostheses

Requirement: An inserted stem inside the femoral outlines and a selected neck length. These data are taken into account in the calculation of the possible rotation center later on.

Result: The current variation was calculated with respect to the pre-operative anatomical situation. To determine the ideal postoperative rotation center, biometric marker point 11 (postoperative center of rotation of the stem) must be adjusted to coincide with the rotation center of the cup.



L: Select hip joint center on prosthesis

R: Exit function

M: Point

Define hip joint center on prosthesis

- L** ● To select the neck center of the stem, use the left mouse button. It is marked as point 11. Point 5 assigned the greater trochanter is renamed automatically to point 12.
- R** To return to the *Hip endoprostheses tool*, use the right mouse button.
- M** Snap-to-point mode is activated to snap to the neck center.

The new, postoperative center point of the joint is marked with 11. Simultaneously, the preoperative point 5 is marked with 12.

Step 13 Define and calculate evaluation circle

13

Define the evaluation circle

Calculate evaluation circle

Delete bad values

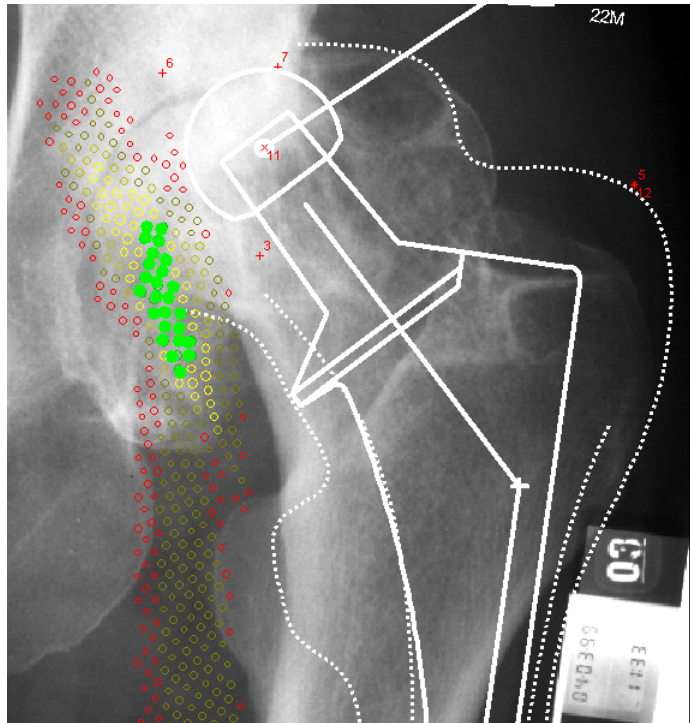
Requirements: The biometric points 11 and 12 are defined.

Result: A circle is drawn. Inside this specific area the Orthopaedic Application evaluates the possible rotation centers with different colors. The hip score is indicated by the color of the points.

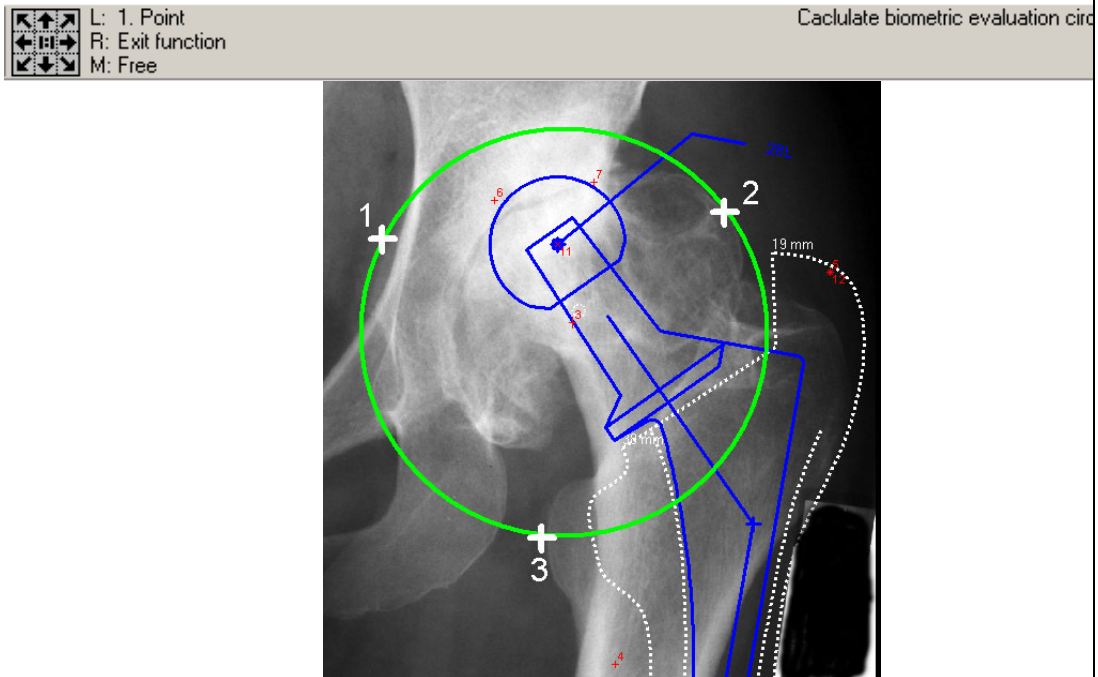
SCORE

- 10-12 points Light green means an ideal, good, or very good hip biomechanics
- 9-7 points Dark green means a satisfying hip joint biomechanics
- 6- 4 points Light yellow means a moderate, unfavorable hip biomechanics
- 3-0 points Dark yellow and red means a poor hip biomechanics

For more detailed information, refer to **Biometry Basics**.



To calculate the possible rotation centers situated within a standardized circle sector, click on two points on the outline of the circle that you want to define, drag the area open with the mouse, and fix it in position with another mouse click.
The Orthopaedic Application evaluates the possible rotation centers inside this specified area.



- | | |
|------------|----------------------------------------------------------------------------------|
| L ● | To choose point 1, 2, and 3 of the evaluation circle, use the left mouse button. |
| R | To return to Module Hip Endoprostheses/ Biometry, use the right mouse button. |
| M | Define the position of the point Free of your choice. |

The biometrical evaluation is displayed automatically (refer to the picture above).

No optimum rotation center found?

If the Orthopaedic Application cannot find any point with a hip score of 7–12, the following strategies usually help you to obtain better evaluation:

- Check the position of the biometric marker points. You can replace individual points.
- Insert another type of prosthesis or vary the neck length. In this case you must reset the rotation center of the prosthesis (point 11).
- Following that, the optimum rotation centers must be recalculated, define the evaluation circle by marking 3 points to enlarge the analyzed area.
- In exceptional cases, no satisfactory score can be achieved.

Step 14 Delete bad biometric values

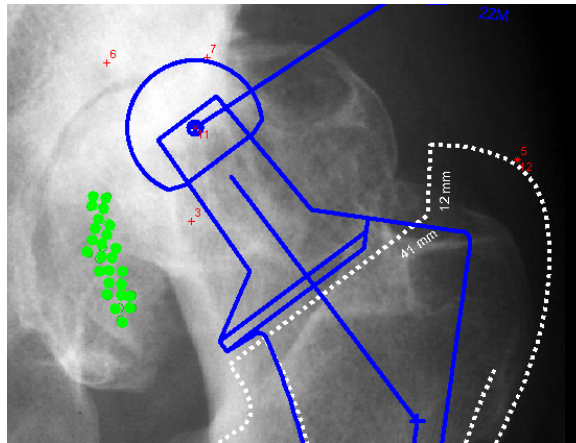
14

- Calculate biometrics
- Delete bad biometric val...**
- Insert cup
- Reposition of shaft/prost

Requirements: An optimal or good biometric zone is available (Score 7-12)

Result: To make the planning image clearer, you can delete the simulation points that have a low hip score.

NOTE: If possible, select only points with a hip score of 10 to 12 to represent the optimum area.



L: Delete score's up to 0
 R: Cancel
 M: Point

Del biometric values by score

L ●

To select the area which surrounds the best values, use the left mouse button. For example, your best zone is light green, click on dark green to delete all other points. In the best zone dark green, click on light yellow to delete all other points.

Step 15 Insert cup **15**

Insert cup
 Reposition of shaft/prost...
 Calculate new biometric...

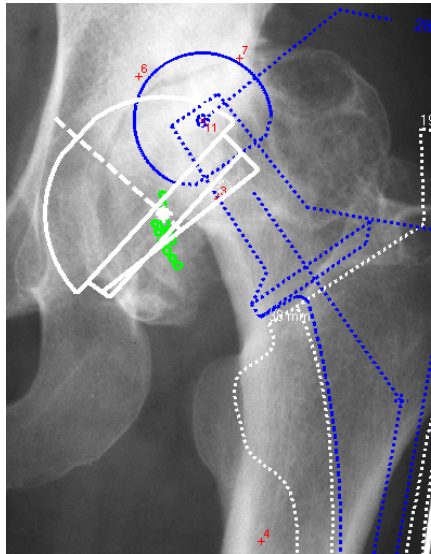
Requirements: good biometric points are displayed.
Result: With the function **Insert cup** the manufacturer, type and size of a cup are selected and inserted within the optimum area and with the required inclination.

NOTE:

For the complete description of this function, refer to **Often used functions** → **Insert a prosthesis**.

WARNING:

All dimensions and measurements given by the Orthopaedic Application prostheses database derive from original manufacturers data or templates. An exemption from liability exists for incorrect or false original prostheses manufacturer data.



After you select the function, you must have the last selected type of prostheses at the mouse pointer. After you select the color (the line under the right side), select the prostheses to define:

manufacturer
 kind of prostheses
 type
 size

The type attached to the mouse pointer always displays the actual selected prostheses.



- L** ● To position the prostheses **temporary**, use the left mouse button. With the ← → keys you can change the inclination. The amount of the angle you change is displayed as **Angle** in the **Macro tool**.
Note: As long as the prostheses in not **finally** positioned, you can change all attributes using the pull-down menus of the Macro tool.
 The type and the size can be also changed by the ↑ ↓ keys.
- L** ● To take and position the prostheses any time again, use the left mouse button.
- R** To finally position the prostheses and return to the **Hip-Endoprotheses** menu, use the right mouse button.
- M** Define the position of the point **Free** of your choice.
 To snap to the hip joint center press the **p** key and activate the snap-to-point mode of the mouse cursor.

The prostheses is positioned.

To move or delete the prostheses, refer to **Often used functions**.

Step 16 Reposition of the stem with the cup

16

Reposition of shaft/prosth...
Biometrics postoperative

Requirements: The cup is inserted within the optimal zone.

Result: when you activated the function all relevant elements to move are marked **automatically**. (stem, outline of femur and biometric point 12.

The rotation center of the stem (neck) and the rotation center of the cup are congruent.

Caution: If necessary the abduction/adduction can be corrected simultaneously. This alters the biometric values.

You are in the function **Copy/Move tool**.

⬅️⬆️⬇️⬅️ L: Select element or define first corner of area
⬅️⬆️⬇️⬅️ R: Finish selection
⬅️⬆️⬇️⬅️ M: Element or LINE

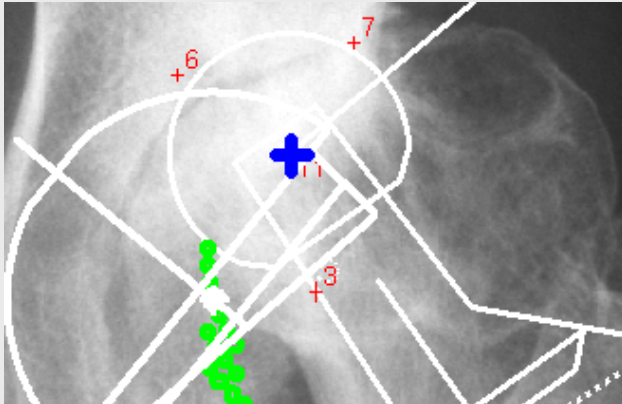
L Using the left mouse button is not relevant because all elements are preselected.

R• To finish the selection marked, use the right mouse button. automatically by the Orthopaedic Application.
NOTE: With this function you can also move the hip geometry together with the cup to change the biometric optimal point for the total geometry. For this you choose the cup before you finish the selection. By changing the point of reposition, you alter the biometric values.

M With this mode the snap-to mode for **Element/Line** is activated.

⬅️⬆️⬇️⬅️ L: Grab point
⬅️⬆️⬇️⬅️ R: Exit function
⬅️⬆️⬇️⬅️ M: Point

L• To select the neck center point (point 11) as **Grab point** of the stem and the outline of the femur, use the left mouse button.



R To back to the **Modules tool**, use the right mouse button.

M. With modus **Point**, the snap-to-point function is activated to choose any point exactly

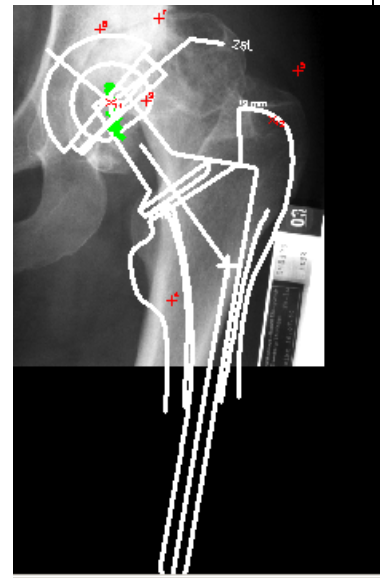
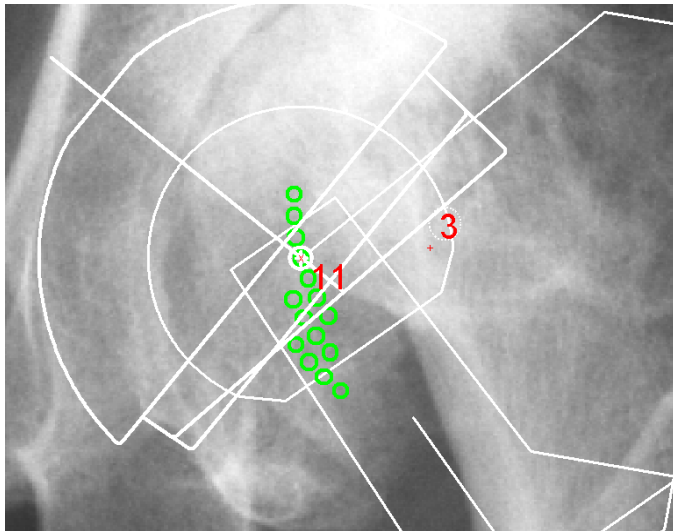
The total geometry (stem and femoral outline) can be moved and rotated by the ← → keys, to correct abduction/adduction again. As a result the position of point 12 and the biometrical values changes.

Use the mouse to move the selected objects such that the neck center point of the stem coincides with the cup center.



- L** ● To move the cursor the way that the neck center of the stem snaps automatically onto the center of the cup, use the left mouse button. The snap-to-point mode makes it easy to position it exactly.
- R** To return to the **Copy/ move tool**, use the right mouse button. The selection for stem/contours/point 12 is no longer automatically activated. To go back to the start **with** an automatic selection press the right mouse button twice and activate the **Reposition of stem/prostheses** function.
- M** With modus **Point** the snap-to-point function is activated to choose any biometric point exactly.

Move the mouse cursor onto the cup center.



The total prostheses geometry is positioned correctly.

Step 17 Calculate new postoperative biometric values

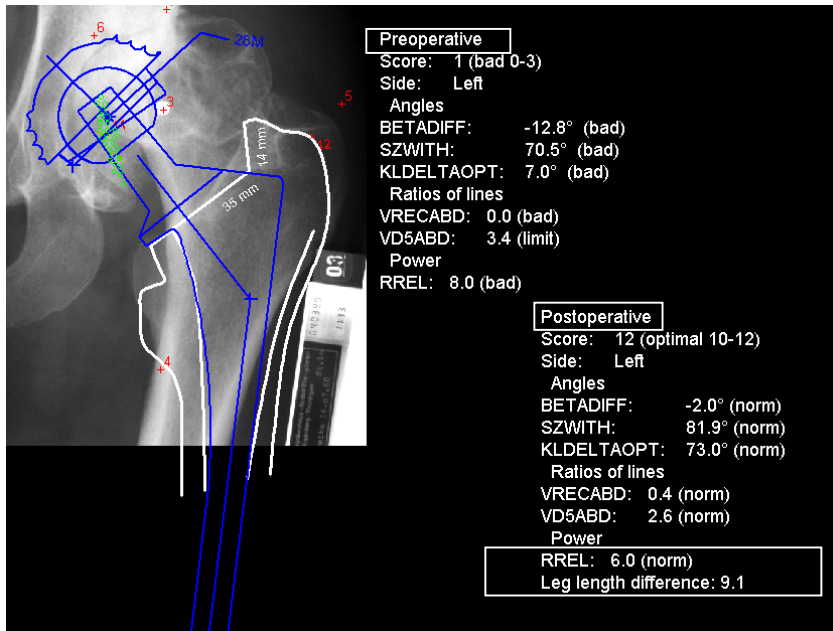
17

reposition of sharp/prosthesis
Biometrics postoperative
 Measure EP, neck/ant obis

Requirements: The new hip joint geometry is positioned as required.

Result: The postoperative calculation attached to the mouse cursor is positioned on the screen beside the preoperative values for comparison. At the same time all values are taken over into **Planning information/Biometry**.

Caution: Only the actual results are displayed in the **Planning information/Biometry**. This guarantees that they always are updated for archiving in the patient database.



Preoperative
Score: 1 (bad 0-3)
Side: Left
Angles
BETADIFF: -12.8° (bad)
SZWITH: 70.5° (bad)
KLDELTAOPT: 7.0° (bad)
Ratios of lines
VRECABD: 0.0 (bad)
VD5ABD: 3.4 (limit)
Power
RREL: 8.0 (bad)
Postoperative
Score: 12 (optimal 10-12)
Side: Left
Angles
BETADIFF: -0.3° (norm)
SZWITH: 80.3° (norm)
KLDELTAOPT: 73.0° (norm)
Ratios of lines
VRECABD: 0.4 (norm)
VD5ABD: 2.9 (norm)
Power
RREL: 6.3 (norm)
Leg length difference: 11.5

Modules

Planning info ...

► Hip-Endoprosthesis/Biometry

Trace outlines

- Femoral outlines
- **Pelvis outlines**

Define hip joint center

- Circle by 3 points
- CCD-angle
- Free

Correct abduction/adduktion
Define biometric points
Insert shaft
Select length of head

Resection

Define HJC-prosthesis

- Calculate biometrics
- Delete bad biometric values
- Insert cup
- Reposition of shaft/prosthesis
- Calculate new biometrics

Measure CIP-relevant data

- **Measure angles**
- **Measure distances**

Plates/Angles/Nails

Screws

The leg length difference is automatically calculated.

Planning informations

Patient/Doctor | Implants | Biometry

Name:

Name: Dr. Test

Description: mediCAD planning

Date: 16.11.2002

Patient:

Name: test

Patient-ID: 12345688

Birthdate: 12.12.1945 Age (years): 53

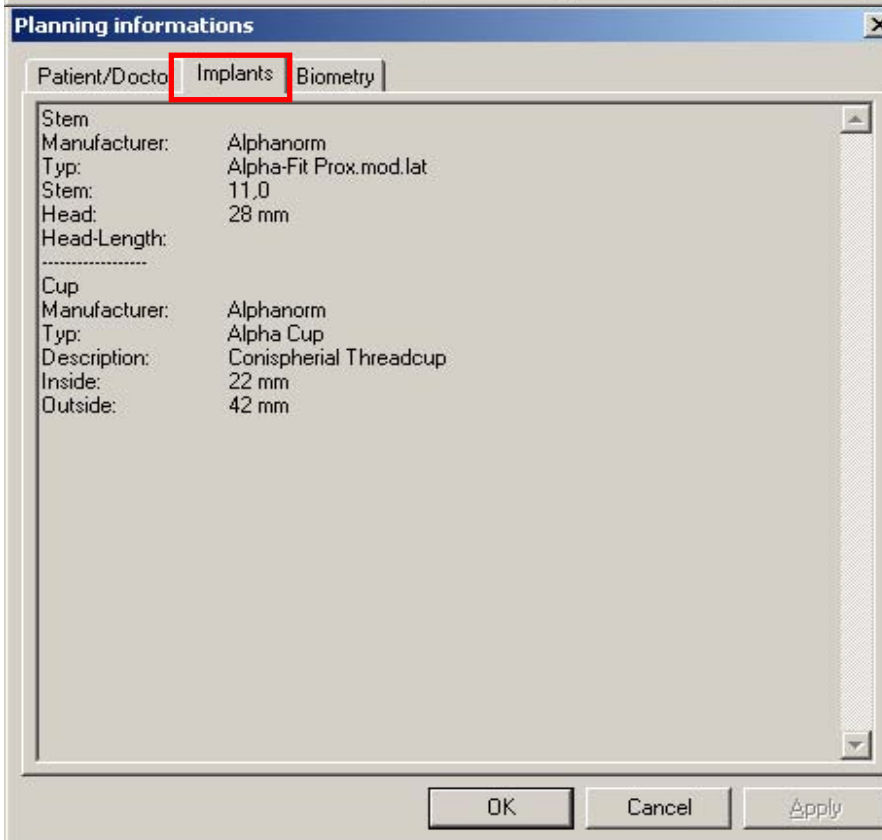
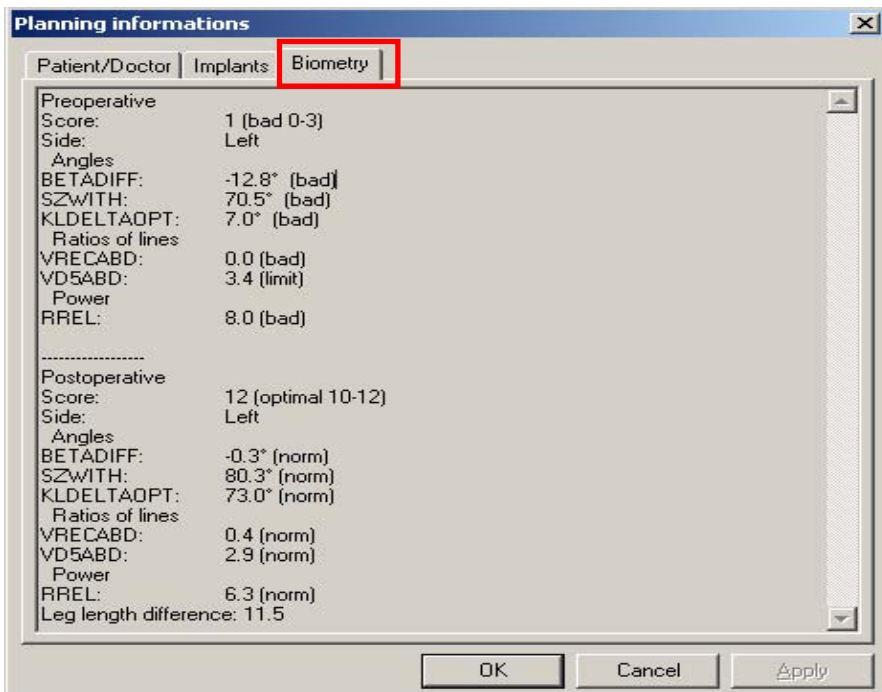
Recording date: 12.12.1998

Size (cm): 1,61

Weight (KG): 75,0

Sex: male
 female

OK Cancel Apply



Step 18 Measurement of op-relevant data

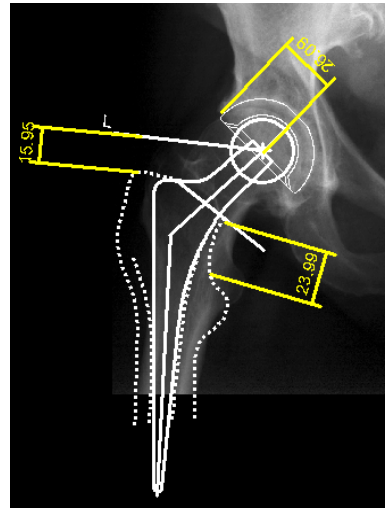
18

Measure OP-relevant data

- Measure angles
- Measure distances

Requirements: An inserted total hip joint geometry

Result. Angles and distances which are helpful for an intraoperative orientation are displayed in degrees and mm. You are in the **Measure distances** function. We suggest some well experienced measurements.

**Note:**

For more information about measurements, refer to **Hip-endoprostheses Step 13 and 13a.**



L: 1. Point
R: Exit function
M: Free

Dimension parallel

L To choose the first point of the distance to measure, use the left mouse button.

R To return to the **Modules tool**, use the right mouse button.

M Define the position of the point **Free** of your choice.



L: 2. Point
R: Back
M: Free

Dimension parallel
Length: 313.6 mm

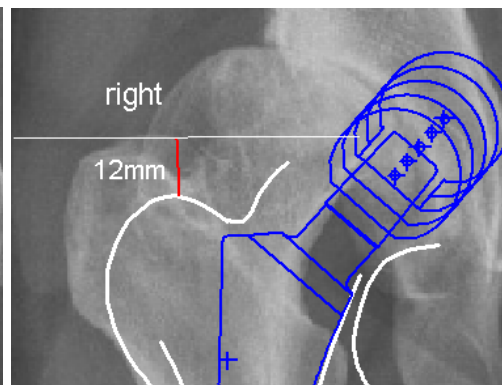
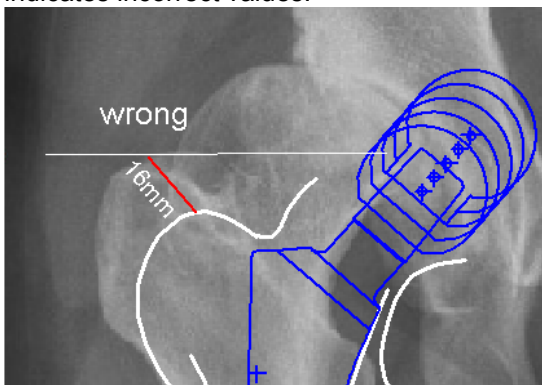
L To choose the second point of the distance to measure, use the left mouse button.

R To return to point 1, use the right mouse button.

M Define the position of the point **Free** of your choice. If useful press the **P** key to change into the mode **Point** and the snap-to-point mode is activated.

Before you choose the second point, the value in mm is indicated on the screen and in the information area. It changes while moving the mouse cursor.

NOTE: To measure the leg length difference, take points which are perpendicular to each other. An inclination of the displayed line between the measurement points sometimes indicates incorrect values.



Knee Endoprosthesis

Basics

The Knee Endoprosthesis module is used for planning knee prostheses. During the planning process you can establish the presence of and correct any axial deformity. Therefore, you can judge the correction of power transmission for the long leg preoperative and postoperative. This results in improved durability of the knee prosthesis.

The Orthopaedic Application provides two different methods of determining the axes and angles and of correcting any deformities.

Both methods require a long leg image in a standing position. After determination of

- Joint center points,
- Knee base lines and
- Anatomical axis

The Orthopaedic Application automatically displays the mechanical axis, the center line, and all relevant angles.

If you only have images showing part of a leg, you can insert the prostheses templates to judge kind and size of the prostheses.

Correction method 1

Correction of malalignments

By drawing two knee base lines, the malalignment (offset of the knee joint centers) can be determined and corrected.

Correction method 2

Correction of malalignments including the ligament

By drawing it, the length of the stretched ligament is determined. The shortened ligament is extended to the length of the stretched ligament or repositioned.

The Orthopaedic Application automatically corrects the malalignment, depending on the required objective (for example, to retain a knee joint center and/or tension of ligament), and calculates the expected postoperative mechanical axes and angles.

Manual correction

With a manual determination of the correction the deformities of axis, center line, and angles are corrected by rotating femur or tibia. While simulating, the physician permanently controls all displayed values and adjusts them with respect to his conception.

Prostheses

Suitable femur and tibia implants can be conveniently selected from a prosthesis database.

Warning: Any axial malalignment can only be calculated correctly if the images used for planning satisfy the following requirements:

- A-P image showing one leg only (taken of both legs) or showing both legs in a standing position with equal load
- Hip joint and ankle joint visible in full
- A lead scale is shown on the image at the height of the longitudinal axis of the femur for calibrating purposes

Composing an image

- A long leg image in a standing position can be easily composed from several images showing part of the leg.
- (If only the knee area is shown on your image, you should only use this image for a rough judgment for the size of the prosthesis.)
It is helpful if a reference scale or a grid is shown on all images.
- For more information about exporting the images, refer to **Basics .- Loading images** at the beginning of the user's manual.

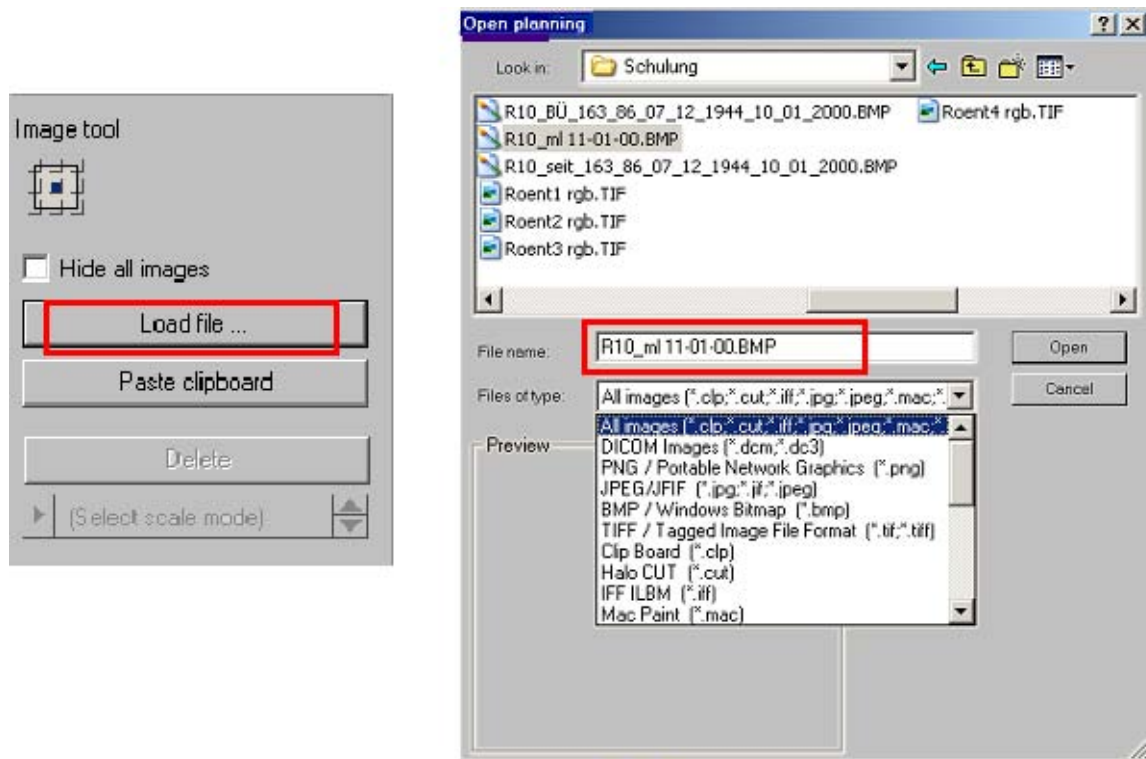
Loading images to the Orthopaedic Application



Complete the following steps.

Activate the function **Images**

1. Select the first image from where it is stored (ensure the file format is correct).
2. The Orthopaedic Application prompts you to **scale** the image.
3. Repeat steps 1+2 until all of the individual images you want to compose are loaded in the Orthopaedic Application.
NOTE: The larger you display the reference scale during scaling, the more precisely you can assemble the individual image later.
4. Click on the images one after the other and move them to the required position. Continue doing this until the images have been correctly positioned.
5. Temporarily save the resulting intermediate image as an Orthopaedic Application planning file **.mpl** to your local hard disk.



Warning:





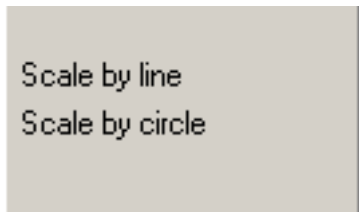









Any axial malalignment can only be calculated correctly if the images used for planning satisfy the following requirements:

A-P image showing one leg only (taken of both legs) or showing both legs in a standing position with equal load.

Hip joint and ankle joint visible in full

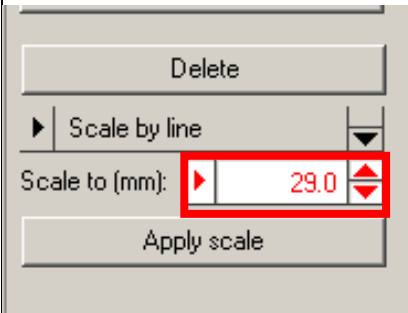
A lead scale is shown on the image (or all parts to be supposed to planning) at the height of the longitudinal axes for calibration purposes.

Procedure

	<p style="text-align: right;">Step 1 Select image 1</p> <p>Select the image and scale it.</p>													
<table border="0" style="width: 100%;"> <tr> <td style="width: 10%;"></td> <td>L: Select image to move or to scale R: Exit function M: Element or Line</td> </tr> <tr> <td>L ●</td> <td>To take the image and position it, use the left mouse button.</td> </tr> <tr> <td>R</td> <td>To exit the function, use the right mouse button.</td> </tr> <tr> <td>M</td> <td>Not relevant</td> </tr> </table>				L: Select image to move or to scale R: Exit function M: Element or Line	L ●	To take the image and position it, use the left mouse button.	R	To exit the function, use the right mouse button.	M	Not relevant				
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R	To exit the function, use the right mouse button.													
M	Not relevant													
	<p style="text-align: right;">Step 2 Select scale mode 2</p> <p>Select the scale mode and scale the image with the reference, which is visible on the screen.</p> <ul style="list-style-type: none"> • With the aid of a distance line when a scale bar is visible • With the aid of a circle when a scaling sphere is visible on the screen 													
<table border="0" style="width: 100%;"> <tr> <td style="width: 10%;"></td> <td>L: 1. Point R: Cancel scaling M: Free</td> </tr> <tr> <td>L ●</td> <td>To define the first point of a line, use the left mouse button.</td> </tr> <tr> <td>R</td> <td>To exit the function, use the right mouse button.</td> </tr> <tr> <td>M</td> <td>Define the position of the point Free of your choice.</td> </tr> </table>				L: 1. Point R: Cancel scaling M: Free	L ●	To define the first point of a line, use the left mouse button.	R	To exit the function, use the right mouse button.	M	Define the position of the point Free of your choice.				
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<table border="0" style="width: 100%;"> <tr> <td style="width: 10%;"></td> <td>L: 2. Point R: Back M: Free</td> </tr> <tr> <td>L ●</td> <td>To define the second point of a line or a the edge of a circle, use the left mouse button.</td> </tr> <tr> <td>R</td> <td>To return to the first point, use the right mouse button.</td> </tr> <tr> <td>M</td> <td>Define the position of the point Free of your choice.</td> </tr> </table>				L: 2. Point R: Back M: Free	L ●	To define the second point of a line or a the edge of a circle, use the left mouse button.	R	To return to the first point, use the right mouse button.	M	Define the position of the point Free of your choice.				
	L: 2. Point R: Back M: Free													
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M	Define the position of the point Free of your choice.													
<p>If you scaled with the aid of a line, scaling now is done. If you scale with the aid of a circle, complete the circle with the third point.</p>														
<table border="0" style="width: 100%;"> <tr> <td style="width: 10%;"></td> <td>L: 3. Point R: Back M: Free</td> <td style="text-align: right;">T:\medicAD\bilder\</td> </tr> <tr> <td>L ●</td> <td>To define the third point of the edge of a circle, use the left mouse button.</td> <td></td> </tr> <tr> <td>R</td> <td>To return to the first point, use the right mouse button.</td> <td></td> </tr> <tr> <td>M</td> <td>Define the position of the point Free of your choice.</td> <td></td> </tr> </table>				L: 3. Point R: Back M: Free	T:\medicAD\bilder\	L ●	To define the third point of the edge of a circle, use the left mouse button.		R	To return to the first point, use the right mouse button.		M	Define the position of the point Free of your choice.	
	L: 3. Point R: Back M: Free	T:\medicAD\bilder\												
L ●	To define the third point of the edge of a circle, use the left mouse button.													
R	To return to the first point, use the right mouse button.													
M	Define the position of the point Free of your choice.													

Step 3 Scaling measurement in mm 3

Fill in the correct measurement of the reference and confirm with **Apply scale** or **Enter**.



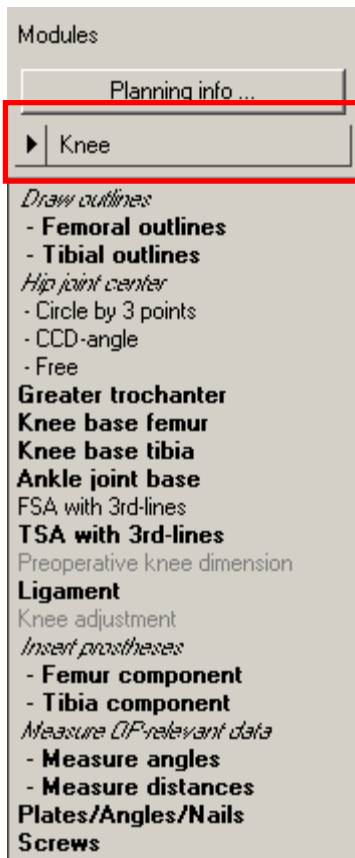
Warning: You can only scale the image correctly if a scale bar or a scaling sphere was placed in the image area while the image was exposed. Check your measurements carefully. False values can have serious consequences for the patient regarding misinterpretations of the right prostheses size.

Note:

After you correctly scale the image, press the right mouse button to exit the function.



Step 4 Select module 4



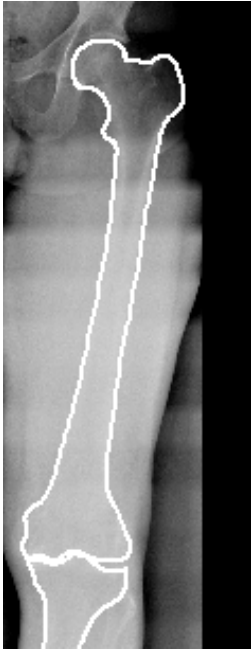
Choose the desired module to work with.

The **Knee Module** is activated. You can exit this module at any time to select another module.

By activating the next steps of the menu, you automatically get into the right function tool and are guided by the **Information bar**.

The support given by the **Information bar** is described next.

Trace outlines
- Femoral outlines
- Tibial outlines
Defina hin mit markier



Requirements: A scaled image
Result: The femoral and the tibial outline are drawn by individual points along the outer corticalis.

You are in the function **Trace outlines**.

NOTE: Distinguish between femoral and tibial outline when activating the function in each case. If both outlines are drawn with the same function, a rotation of the femur against the tibia is **not** possible.

After you select the kind, color and size of the line, click one point after the other, following the contour. The spline function requires less intermediate points for straight lines than for curves.
Note: To reject points, go to the **Reject points** function or press the backspace key (above return). You **reject last point** step-by-step and continue drawing.

	L: first point R: Exit function M: Free	Contours
--	-----------------------------------------------	----------

- L** ● To define the first point of the femur outline, use the left mouse button. The Femur outline is one line around the complete femuoral outline
- R** To exit the function, use the right mouse button.
- R** ● With the second. mouse click you return to the **Module tool** and chose the Tibia contour next.

Caution:
Draw the outer corticalis of tibia the in the same way but with the function tibial outline.

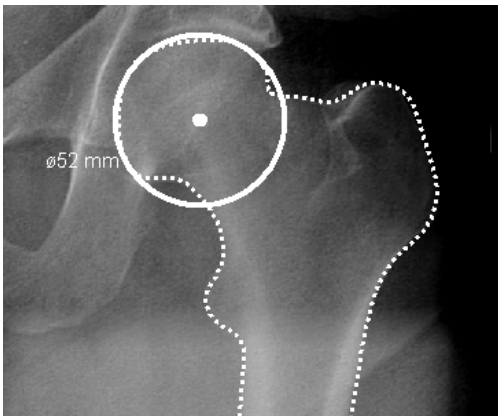
NOTE: If you forgot one outline or you delete one to draw it again, return to the **Femoral outlines/tibial outlines** function, select the **Group by** → **femur outline/tibial outline** function, and repeat drawing as described above.

After exit the function return to the **Module tool** and choose the next dimmed written function.

Step 6 Define hip joint center(HJC) **6**

- Define hip joint center*
- Circle by 3 points
 - LCD-angle
 - Free

Requirements: A scaled image
Results: A circle is drawn by 3 points, the circle and the diameter in mm temporary appears, the center point of the circle is defined and drawn.



You are in the function **Circle by 3 points (HJC)**. After you select the kind, color, and size of the line, start drawing the circle.

	L: 1. Point R: Exit function M: Free	HJC by 3 points
--	--------------------------------------------	-----------------

- L** ● To select the first point (for example, on the edge of the hip head), use the left mouse button.
- R** To exit the function, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

	L: 2. Point R: Back M: Free	HJC by 3 points
--	-----------------------------------	-----------------

- L** ● To select the second point (for example, on the edge of the hip head), use the left mouse button.
- R** To return to the first point, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

	L: 3. Point R: Back M: Free	HJC by 3 points
--	-----------------------------------	-----------------

- L** ● To drag open a circle which fits as exactly as possible the hip joint capsule, use the left mouse button.
- R** To return to the first point, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

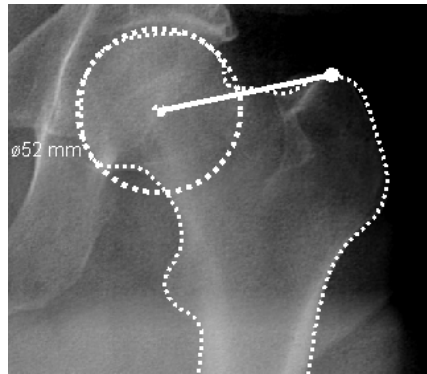
The hip head center point is displayed.

Step 7 Select Trochanter Major **7**

Greater trochanter

~~Knee base femur~~

Requirements: A hip joint center is displayed
Results: A connecting line between the hip joint center and the most cranial point of the greater trochanter is displayed. The direction of this line defines for the Orthopaedic Application the body side.



The function **Trochanter major** is activated.
 After you select the kind, color and size of the line, start drawing the connecting line.
 The starting point is automatically the hip head center.

	L: Place greater trochanter R: Exit function M: Free	Greater trochanter
--	------------------------------------------------------------	--------------------

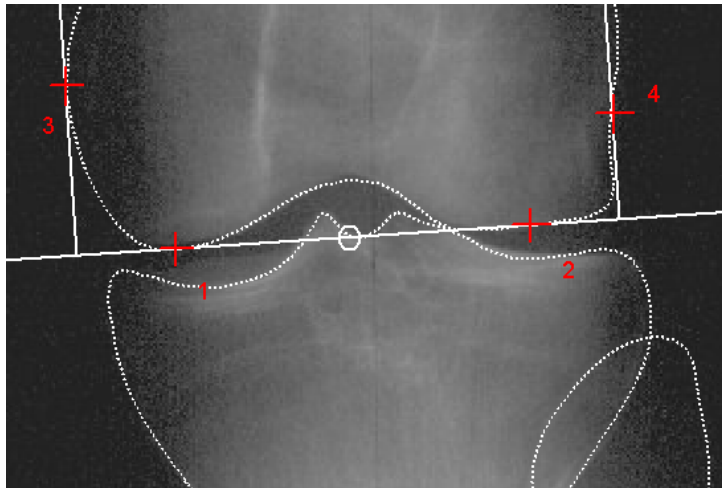
- L** ● To drag the line up to the most cranial point of the greater trochanter, use the left mouse button.
- R** To return to the **Module tool**, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The connecting line is drawn, the actual body side is defined.

Step 8 Define femoral knee base **8**

- Knee base femur**
- ~~Knee base tibia~~
- ~~Ankle joint base~~

Requirements: Drawn femoral outline
Results: The femoral joint base line is positioned and the femoral knee base center is automatically calculated by drawing two perpendicular lines that form a tangent to the lateral and medial femur condyles.



The **Knee base femur** function is activated. After you select the kind, color and size of the line, start drawing the tangential line on the distal condyles (refer to the picture above point 1 and 2).

	L: 1. of 2 base line points R: Exit function M: Free	Knee base femur
--	------------------------------------------------------------	-----------------

- L** ● To click on the first most distal point of the medial /lateral femoral condylus (refer to the picture above point 1), use the left mouse button.
- R** To return to the **Modules tool**, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

	L: 2. of 2 base line points R: Back M: Free	Knee base femur
--	---------------------------------------------------	-----------------

- L** ● To click on the second most distal point of the medial or lateral femoral condylus (refer to the picture above point 2), use the left mouse button.
- R** To return to point 1, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The femoral basic line is displayed. A perpendicular line automatically appears.

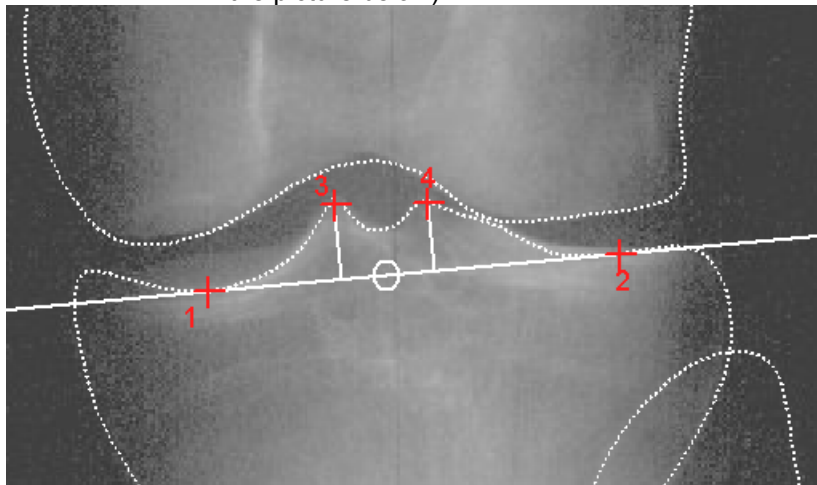
	L: 1. of 2 limits R: Back M: Free	Knee base femur
L R M	Drag the mouse pointer upwards; move the perpendicular to a position where it forms a tangent to the lateral femur condylus (3) and click to confirm. To return to the second point of the basic line, use the right mouse button. Define the position of the point Free of your choice.	
The knee base center already appears. It changes the position dependent on the movements of the mouse pointer. Define the femoral knee base center in the middle of the distance of the first and the second perpendicular line.		
	L: 2. of 2 limits R: Back M: Free	Knee base femur
L R M	Drag the mouse pointer upwards; move the perpendicular to a position where it forms a tangent to the medial femur condylus (4) and click to confirm. To return to the first lateral tangent, use the right mouse button. Define the position of the point Free of your choice.	
The femoral knee base line and the knee base center are displayed.		

Step 9 Define tibial knee base **9**

Knee base femur
Knee base tibia
 Ankle joint base

Requirements: Drawn femoral knee base

Results: The tibial joint base line is positioned and the tibial knee base center is automatically calculated by drawing two perpendicular lines that form a tangent to the lateral and medial tibia condyles (alternatively you can use the eminentiae, refer to the picture below).



The function **Knee base tibia** is activated. After you select the kind, color and size of the line, start drawing the tangential line on the proximal tibial condyles (refer to the picture above point 1 and 2).

	L: 1. of 2 base line points R: Exit function M: Free	Knee base tibia
--	------------------------------------------------------------	-----------------

- L** ● To click on the first point of the medial /lateral tibial condylus (refer to the picture above point 1), use the left mouse button.
- R** To return to the **Modules tool**, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

	L: 2. of 2 base line points R: Back M: Free	Knee base tibia
--	---------------------------------------------------	-----------------

- L** ● To click on the second point of the medial/lateral tibial condylus (refer to the picture above point 2), use the left mouse button.
- R** To return to point 1, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The tibial base line is displayed. A perpendicular line automatically appears.

	L: 1. of 2 limits R: Back M: Free	Knee base tibia
--	-----------------------------------------	-----------------

- L** ● Drag the mouse pointer upwards; move perpendicular to a position where it forms a tangent to the lateral tibial condylus (3)/eminentia and click to confirm.
- R** To return to the second point of the basic line, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The knee base center already appears. It changes the position dependent on the movements of the mouse pointer. Define the tibial knee base center in the middle of the distance of the first and the second perpendicular line.

	L: 2. of 2 limits R: Back M: Free	Knee base tibia
--	-----------------------------------------	-----------------

- L** ● Drag the mouse pointer upwards; move perpendicular to a position where it forms a tangent to the medial tibial condylus (4)/eminentia and click to confirm.
- R** To return to the first lateral tangent, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The tibial knee base line and the knee base center are displayed.

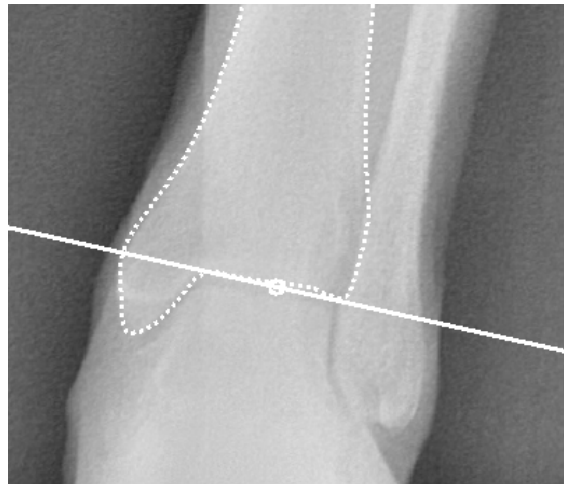
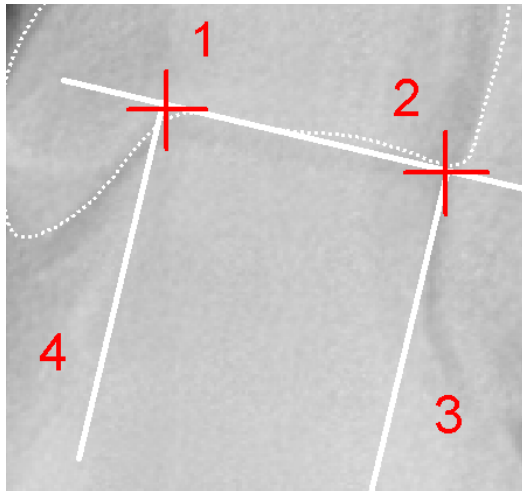
Step 10 Define ankle joint base 10

Ankle joint base
FSA with Str-lines

Requirements: The hip joint center (HJC), femoral and tibial knee base center are defined.

Results: The ankle joint basic line and the center are displayed.

The function **Ankle joint base** is activated.



You are in the function **Ankle joint base**.

After you select the kind, color and size of the line, start drawing the tangential line from point 1 to point 2.



L: 1. of 2 base line points
R: Exit function
M: Free

Ankle joint base

- L** ● To click on the first point distal of the distal tibial base (refer to the picture above point 1), use the left mouse button.
- R** To return to the **Modules tool**, use the right mouse button.
- M** Define the position of the point **Free** of your choice.



L: 2. of 2 base line points
R: Back
M: Free

Ankle joint base

- L** ● To click on the second point distal tibial base (refer to the picture above point 2), use the left mouse button.
- R** To return the first point, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The ankle joint basic line is displayed. A perpendicular line appears automatically.



L: 1. of 2 limits
R: Back
M: Free

Ankle joint base

- L** ● Drag the mouse pointer upwards; move perpendicular to a position where it forms a tangent to the talus (point 3) and click to confirm.
- R** To return to the second point of the basic line, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The ankle joint center already appears. It changes the position dependent on the movements of the mouse pointer. Finally you define the ankle joint center in the middle of the distance of the first and the second perpendicular line.



L: 2. of 2 limits
R: Back
M: Free

Ankle joint base

- L** ● Drag the mouse pointer upwards; move the perpendicular to a position where it forms a tangent to the talus (point 4) and click to confirm.
- R** To return to the first lateral tangent, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The base line and the ankle joint center are displayed.

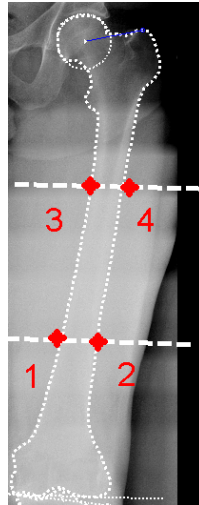
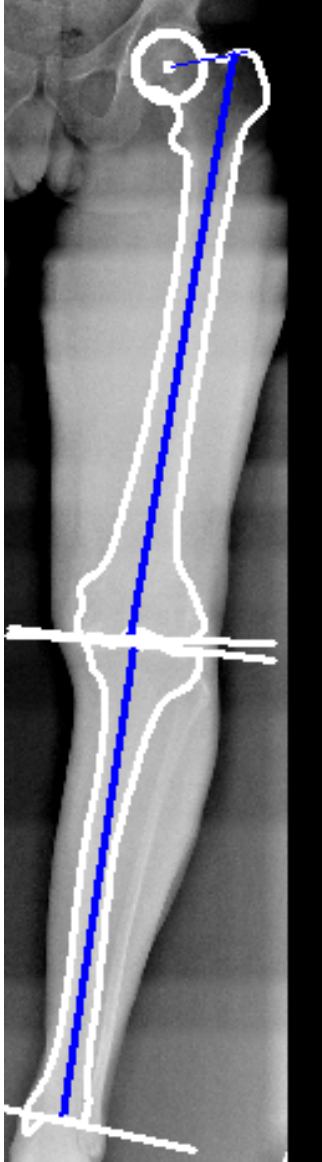
- Ankle joint base
- FSA with 3rd-lines**
- TSA with 3rd-lines**
- Preoperative knee dimension
- Ligament

Step 11 Define femoral/tibial anatomical axis

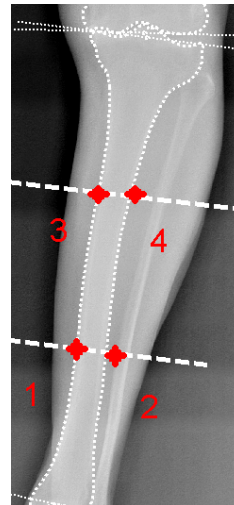
Requirements: Displayed joint center of the hip, knee and ankle joint

Result: Both anatomical axis are displayed in a preview graphic and form the basis of the preoperative situation of all axis.

Auxiliary lines for drawing the axis are lines which divide the distance between the hip joint center, the femoral knee joint center (femur shaft axis FSA), the tibial knee joint center, and the ankle joint center (tibial shaft axis TSA) into 3 equal sections. Refer to the pictures below.



FSA



TSA

You click on the four points (1, 2 and 3, 4) in pairs where the auxiliary lines intersect the outer cortical layer. The result is the anatomical axis through the center between the points 1-2 and 3-4.

You are in the function **FSA with 3rd** lines.
 The procedure is identical for both axis.
 After you select the kind, color and size of the line, select one of both functions and draw the axis.
 Draw the second axis in the same way.
 The points 1, 2, 3 and, 4 each are intersection points of the auxiliary lines and the bone outlines.

	L: Define 1. of 4 points R: Exit function M: Element or Line	FSA with 3rd-lines
--	--------------------------------------------------------------------	--------------------

- L ●** To select the intersection point 1, use the left mouse button.
- R** To return to the **Knee prostheses tool**, use the right mouse button.
- M** With modus **Item/Element** the snap to line function is activated to snap to the bone outline.

	L: Define 2. of 4 points R: Back M: Element or Line	FSA with 3rd-lines
--	-----------------------------------------------------------	--------------------

- L ●** To select the intersection point 2, use the left mouse button.

	L: Define 3. of 4 points R: Back M: Element or Line	FSA with 3rd-lines
--	-----------------------------------------------------------	--------------------

- L ●** To select the intersection point 3, use the left mouse button.

	L: Define 4. of 4 points R: Back M: Element or Line	FSA with 3rd-lines
--	-----------------------------------------------------------	--------------------

- L ●** To select the intersection point 4, use the left mouse button.

The anatomical femoral axis is automatically displayed.

Now you repeat the same procedure with the function **TSA with 3rd lines** and draw the anatomical femoral shaft axis.

NSA with arc-lines
Preoperative knee dimension
 Ligament
 Knee adjustment

Requirements: All joint centers and the anatomical axis must be displayed.

Result: All preoperative, mechanical axis, the center line and all angles and lengths are automatically completed and displayed.

Scheme and abbreviations :

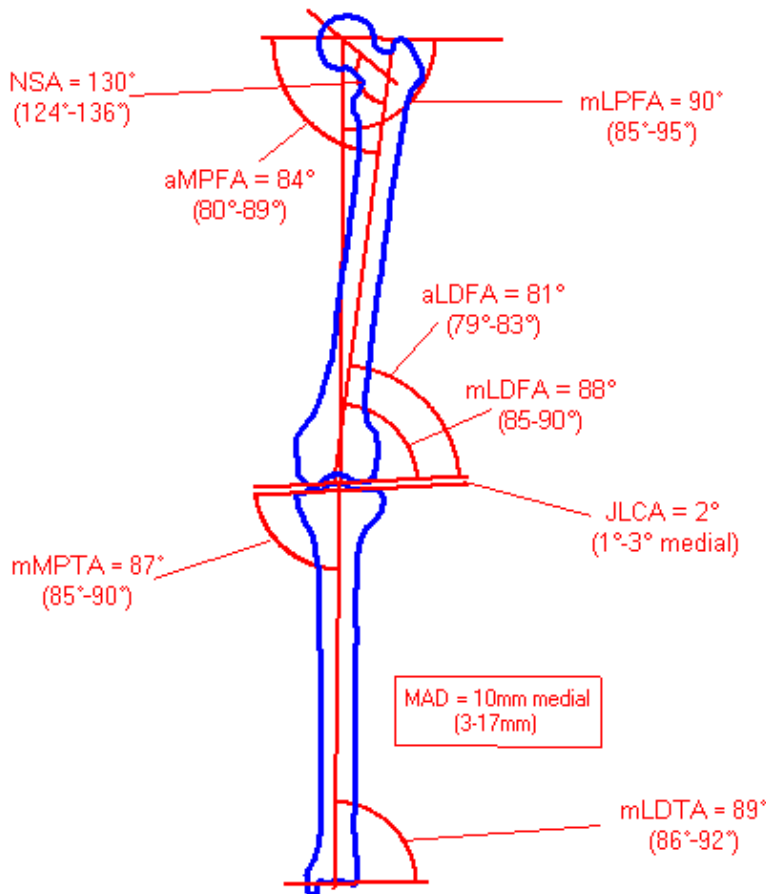
m	mechanical	a	anatomical
L	lateral	M	medial
D	distal	P	proximal
F	femur	T	tibia
A	angle/axis		

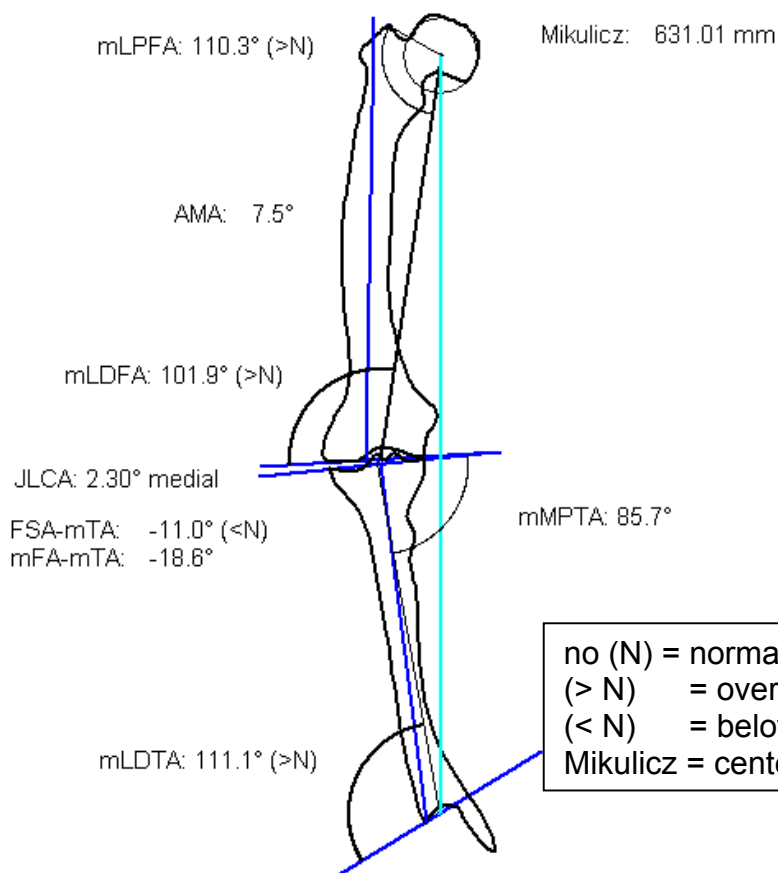
- NSA Neck Shaft Angle (CCD-angle)
- KJL-F Knee Joint Line – Femur (proximal knee base)
- KJL-T Knee Joint Line – Tibia (distal knee base)
- JLCA Joint Line Conversion Angle (angle between KJL-F and KJL-T)
- AMA Anatomical Mechanical Angle (angle between anatomical and mechanical axis)
- MAD Mechanical Axis Deviation
- ACA Angle of Correction of Angulation (only for module Osteotomy II, here not relevant)
- RDA Real Deformity Angle (only for module Osteotomy II, here not relevant)

The nomenclature of all value as Dror Paley Standard Measurements

Glossary and deformity correction principles. Gaslini 29:1 (1997) 5-9

Normal values overview (the normal values are described in the following work:
 Paley, Dror: Principles of Deformity Correction 2002)



Actual preoperative measurements

You activate the function **Preoperative knee dimensions** and automatically have the preview with all relevant dimensions attached to the mouse cursor.



L: Destination point
 R: Exit function
 M: Free

Measure femure ΔP

- L** ● To move the preview to the desired position, use the left mouse button.
R To return to **Module knee tool**, use the right mouse button.
M Define the position of the point **Free** of your choice.

NOTE: An overview of the angles and their values are important for further judgments, for intraoperative decisions and for documentation.

NOTE: Position the object on the **left** next to the x-ray. This leaves enough space for the previews of the postoperative joint situation on the right side to the x-ray.

Basics:

You can correct the axis situation with respect to the ligament or without.

1. Conditions for a preview **with** ligament correction:
 The stretched ligament has to be drawn.
 The shortened ligament is extended to the length of the stretched ligament.
2. Conditions for a preview **without** ligament correction:
 The ligament is not needed. The function **Keep ligament length** has to be deactivated if the ligament is already drawn.
 If necessary, activate the function **align preview vertically** if it is not done automatically.

Both methods correct the preview automatically so that the center line is vertical and the knee joint centers are inline with the centerline. The mechanical axis and the center line are identical.

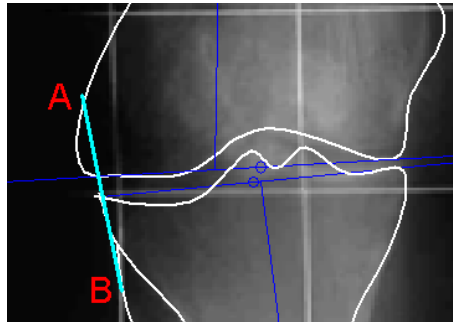
Choose the method in the **Knee tool**.

Draw the Ligament:



Requirements: The anatomical axis are drawn and the preoperative is displayed.

Result: The stretched ligament is displayed (A to B).



You are in the function **Joint/axis tool**. After you select the kind, color, and size of the line, define the length of the ligament (refer to the picture above from A to B).

	L: Ligament end femur R: Exit function M: Free	Ligament
L ●	To define point A = Ligament end on the distal femur, use the left mouse button.	
R	To start again, use the right mouse button.	
M	Define the position of the point Free of your choice.	
	L: Ligament end tibia R: Back M: Free	Ligament
L ●	To define point B = Ligament end on the proximal fibula, use the left mouse button. You automatically return to the Module tool .	

With drawing the ligament, the length is defined too.

Step 14 Description for corrections step 14a +14b **14**

Knie adjustment

Requirements: The anatomical axis is drawn and the preoperative preview is displayed.

Result: Either the axis correction is automatically done by the Orthopaedic Application or correction is done by several manual options.

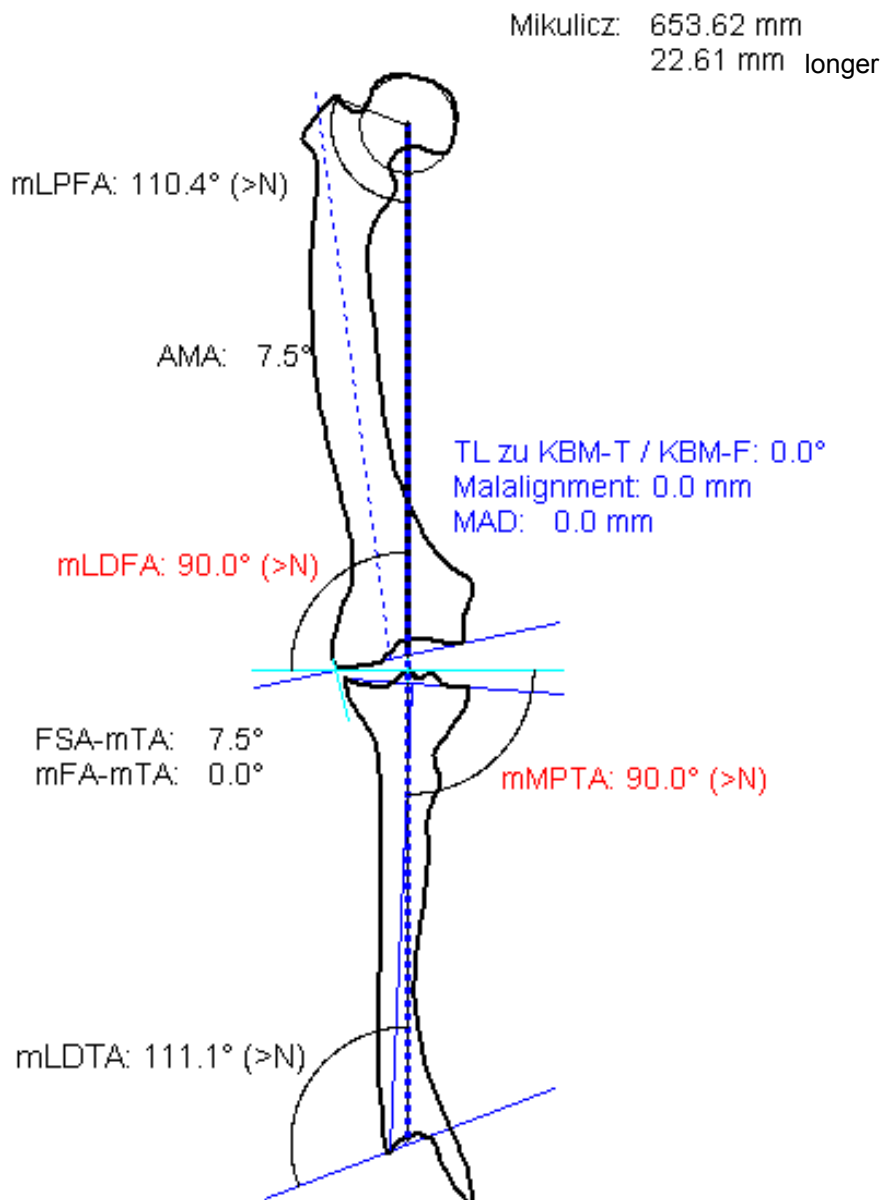
The result is displayed on the desired position and all relevant values are shown.

Basics

Result with the correction of the ligament

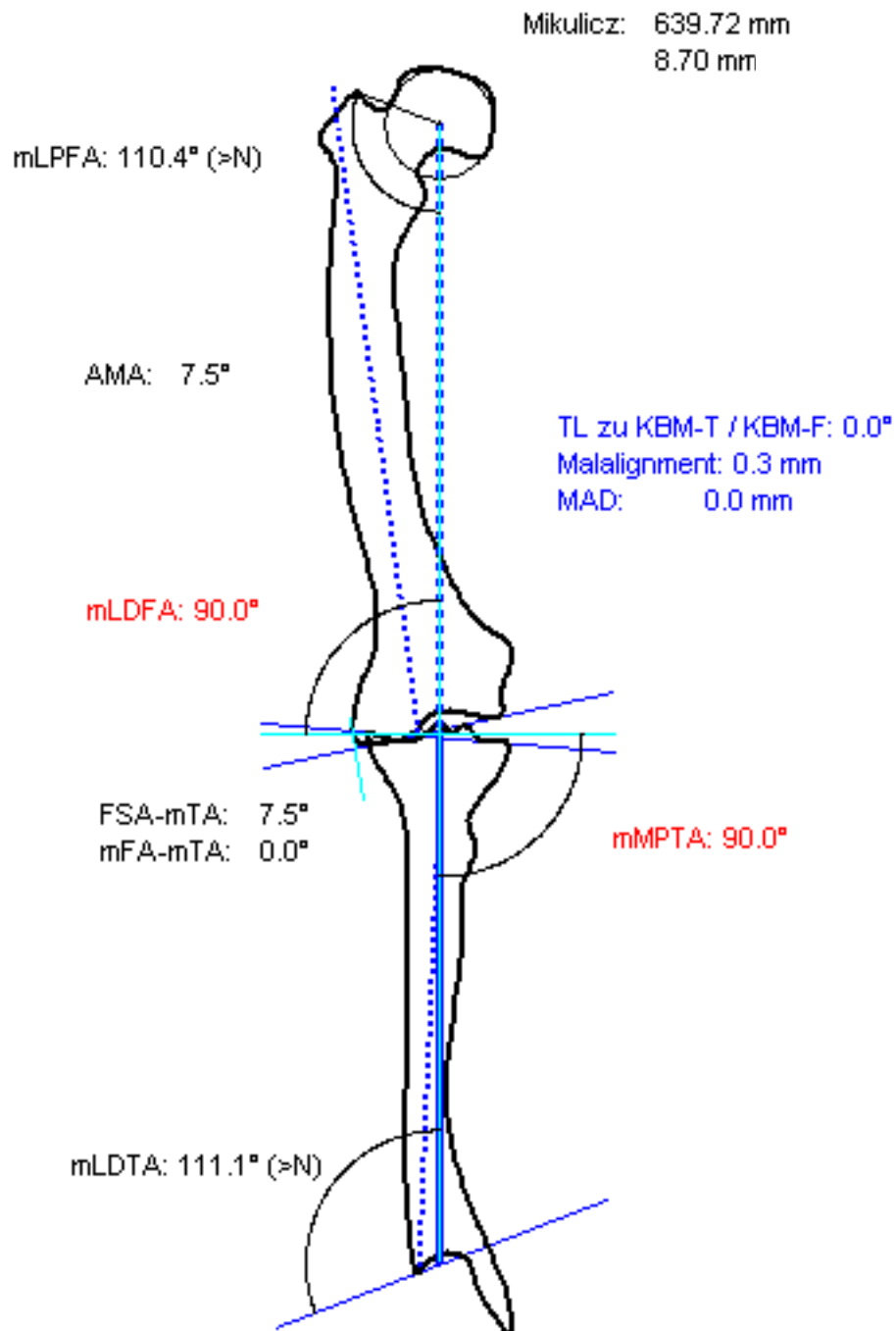
The knee joint center points are on the center line, The center line is identical with the mechanical axis.

The shortened ligament is stretched. The length of the stretched ligament remains unchanged. The length of the center line (Mikulicz) is displayed. (here 22.61 mm longer).



Result without the correction of the ligament

The knee joint center points are on the center line, The center line is identical with the mechanical axis. The length of the center line (Mikulicz) is displayed. (here 8.70 mm longer).



Step 14a Knee adjustment with ligament correction

14
a



At first the correction of the stretched ligament is described. After you activated the function **Knee adjustment**, the corrected preview is automatically attached to the mouse pointer.



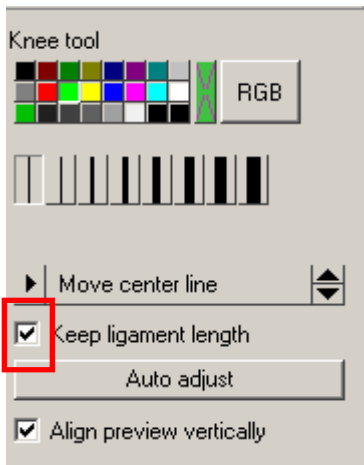
- L** • To drag the graphic to the desired position, use the left mouse button.
- R** To return to the **Module tool**, use the right mouse button.
- M** Define the position of the point **Free** of your choice.



If you accept the correction without changes, press the right mouse button and confirm with the left mouse button at one of the functions:



- With **Apply** you conform or press **Return**.
- With **Reject** you return to the **Module tool**.
- With **Back** you return to the **Knee tool** and start a correction again.



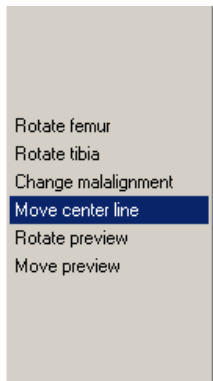
The **Knee tool** is activated.

Click on the pull-down menu to activated the required function for your correction (for a description refer to the picture below).

Keep ligament length is preselected if the ligament is drawn. The preview generates an identical ligament length lateral and medial. If the ligament is not drawn this function is deactivated.

The preview is automatically aligned. The center line is perpendicular to the knee base line.

For manual changes of the preview, activate the pull-down menu and select the function you want to use for manual correction.



Following options are possible:

- Rotate femur while the tibia remains at the same position
- Rotate tibia while the femur remains at the same position
- Change malalignment, the position of each knee base center changes
- Move center line, you position the center line free of choice
- Rotate preview
- Move preview to another position on the screen.

ref. 1 **Rotate Femur**

To activate this function, click with the mouse cursor at any position inside or outside the femoral contour. Rotate the femur by moving the mouse. The tibial contour remains at the same position. The femoral contour moves and the displayed values are changing at the same time.

Click with the left mouse button when you achieved the desired result.

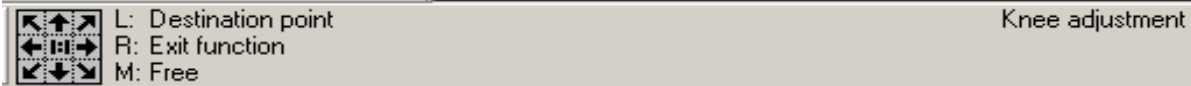
Confirm finally with **Enter** or with **Apply** (to display the window press the right mouse button), to apply the preview press the left mouse button on **Apply** or return to the **Knee tool** to select another option.

Step 14b Correction malalignment only

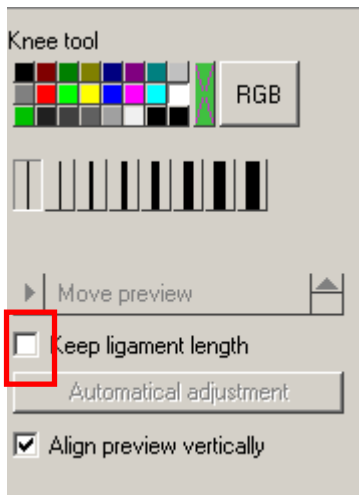
14
b



The correction of the malalignment **without** correcting the stretched ligament is described. After you activated the function **Knee adjustment** the corrected preview is automatically attached to the mouse pointer.



- L** ● To drag the graphic on the desired position, use the left mouse button.
- R** To return to the **Module tool**, use the left mouse button.
- M** Define the position of the point **Free** of your choice.



The **Knee tool** is activated.

Click on the pull-down menu to activated the required function for your desired manual corrections (refer to the description under **14a**)

Caution:
Keep ligament length is preselected **if the ligament is drawn**. To calculate a preview with the ligament correction only you must deactivate the **Keep ligament length**.



If you accept the correction without changes, press the right mouse button to open the window and confirm with the left mouse button **Apply** or press **Return**.

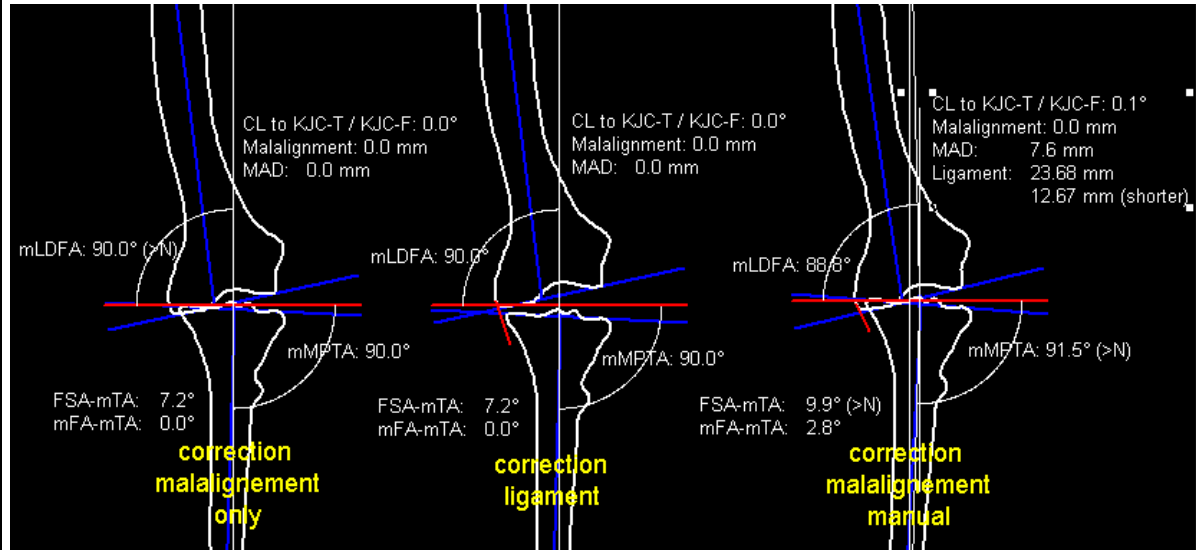


With **Reject**, you return to the **Module tool**.

With **Back**, you return to the **Knee tool** and start again.

NOTE:

To work out the best compromise for your patient place previews as many as you like on the screen according to different requirements.



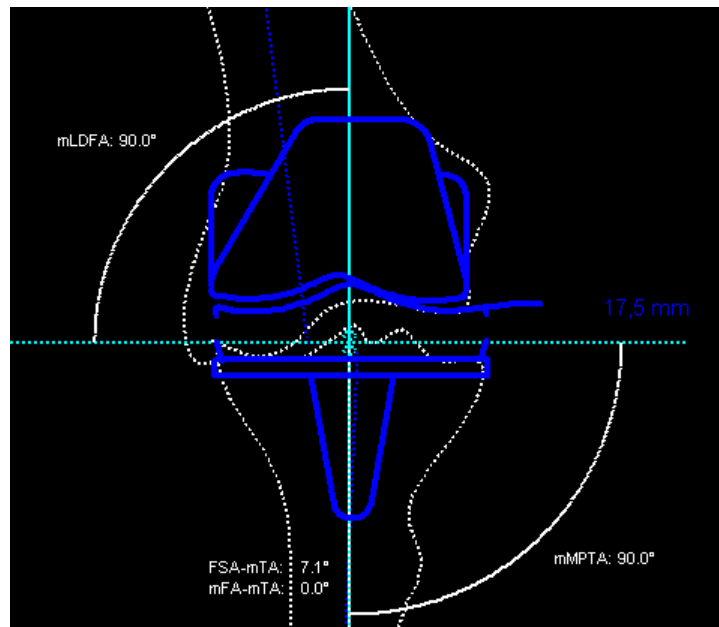
Insert protheseses
- Femur component
- Tibia component
Messung von OP-relevanten Daten

Step 15 Insert protheseses components

15

You can now insert the required protheseses components for indication of size and/or type and define relevant measurements

WARNING:
 All dimensions and measurements given by the Orthopaedic Application protheseses database derive from original manufacturers data or templates. An exemption from liability exists for incorrect or false original protheseses manufacturer data.



Step 16 Draw measurements in mm

Measure OP-relevant data
- Measure angles
- Measure distances
Messung von OP-relevanten Daten

For a description, refer to Module *Hipendoprotheses Step 13 and 13a.*

Coxometry

The Coxometry module enables you to assess hip joints on the basis of clinically relevant values.

As American and European orthopaedic surgeons use different criteria to assess the hip situation, the procedures used in Coxometry take country-specific differences into account. All functions for calculation are activated with the **Modules tool**.

Some criteria are evaluated automatically by the Orthopaedic Application using grading tables, for example, the acetabulum-femoral head index or the angle of acetabular inclination. A detailed description of these hip parameters and information on their evaluation can be found in the following description

Select the functions appropriate to the clinical purpose and to your personal working approach.

Documentation

By saving and printing the planning images you can monitor and document progress from diagnosis through to the end of treatment.

Basics

The Coxometry module uses a number of different measurable angles and distances to provide indicators for assessing pathological and non-pathological hip joint situations. These hip joint values differ in children and adults.

The values are weighted differently depending on the course of the disease and can also be observed in isolation.

The hip values are described in alphabetical order below:

- ACE angle according to Wiberg or CE angle = anterior center-edge angle
- ACW Acetabular angle:
AC-SZW: acetabular angle (angle of sclerotic area of the roof of the acetabulum if the Y-cartilage is closed)
AC-Hilg: acetabular angle according to Hilgenreiner (if the Y-cartilage is open)
- ACM angle according to Idelberger and Frank
- CCD angle
- HW = hip index according to Busse, Gasteiger and Tönnis
- HPKI = acetabulum-femoral head index according to Heymann and Herndorn
- MZ = decentralized distance line used to calculate the hip index
- PFNW = acetabular inclination angle according to Ullmann

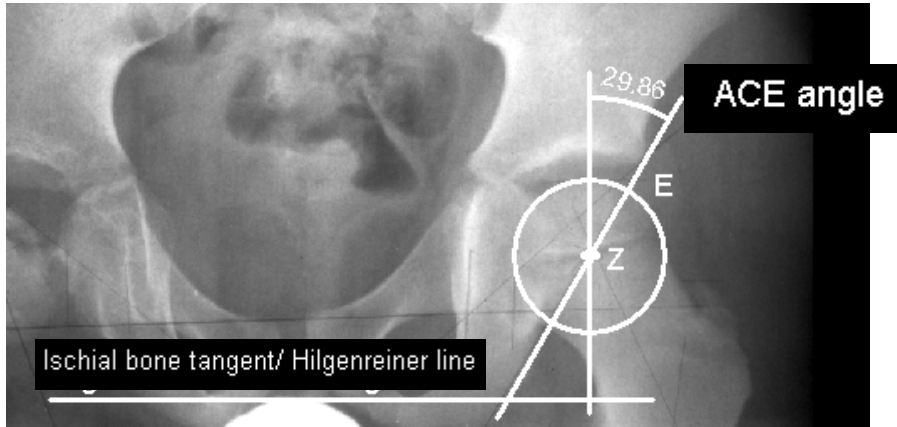
The Orthopaedic Application uses tables familiar from medical literature for evaluation.

ACE-angle according to Wiberg

CE-angle

Wiberg angle and CE angle are synonyms. CE angle is an abbreviation for center-edge angle. The CE angle is a dimension used for precise assessment of the development of the roof of the acetabulum in patients with hip-joint dislocation or dysplasia of the hip. It is the angle formed by the following lines:

- Parallel line to the longitudinal axis of the body positioned through the center of the femoral head
- Straight line running through the lateral edge of the acetabulum and the center of the femoral head



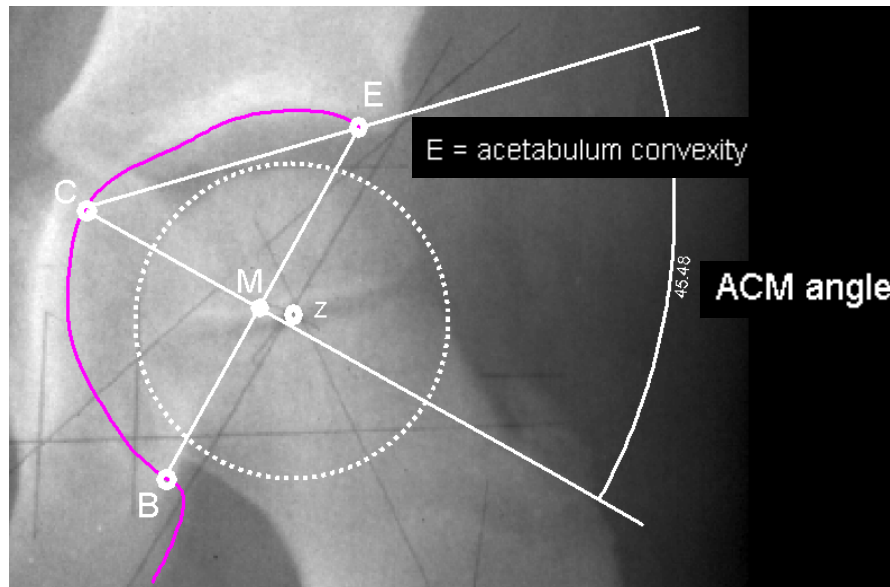
E: acetabulum convexity
 Z: center of femoral head
 T: tangent to ischial bone

Evaluation					
Age	Normal value Mean	Grade 1 Normal	Grade 2 slightly pathological.	Grade 3 gravely pathological.	Grade 4 extremely pathological.
0- ≤8	25	≥20	≥15-<20	≥0-<15	0
≥8-≥18	32	≥25	≥20-<25	≥5-<20	<5
>18-∞	35	≥30	≥20-<30	≥5-<20	<5

(Further information can be found in *Hellinger: Messmethoden in der Skelettradiologie* (1995)).

ACM-angle according to Idelberger and Frank

The ACM angle according to Idelberger and Frank is an indicator for the development of the acetabulum.



B: most caudal point of acetabulum edge
 C: intersection of acetabulum floor and the perpendicular to the line BE
 E: acetabulum convexity
 M: point half way along the line EB

Evaluation (from 2 years of age)

Age	Normal value Mean	Grade 1 Normal	Grade 2 slightly pathological.	Grade 3 gravely pathological.	Grade 4 extremely pathological.
>2	45	<50	≥50-<55	≤55-<60	≥60

Further information can be found in *Idelberger, K.: Lehrbuch der Orthopädie (1984).*

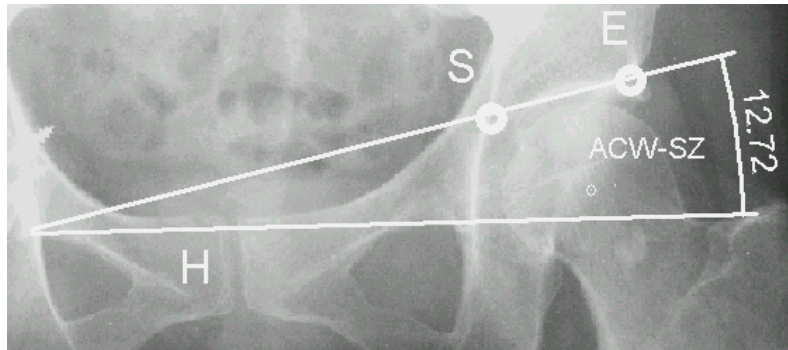
ACW-SZ

ACW-HL Acetabular angle

The acetabular angle indicates the steepness of the acetabulum, such as the degree of any dysplasia present.

ACW-SZ

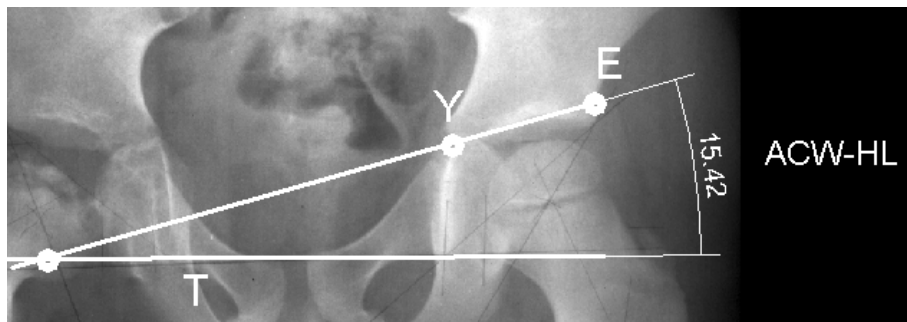
If the Y-cartilage is closed, the acetabular angle is measured between the line parallel to the Hilgenreiner line and the line running through the laterocranial acetabulum convexity and the edge of the sclerotic area.



E: laterocranial acetabulum convexity
 H: line parallel to the Hilgenreiner line
 S: edge of the sclerotic area

ACW-HL

If the Y-cartilage is still open, the acetabular angle according to Hilgenreiner is measured (AC-HL) = angle between the ischial bone tangent and the line running through the laterocranial acetabulum convexity and the Y-cartilage.



E: laterocranial acetabulum convexity
 T: ischial bone tangent
 Y: Y-cartilage

Age	Normal value Mean	Grade 1 Normal	Grade 2 slightly pathological.	Grade 3 gravely pathological.	Grade 4 extremely pathological.
<4M	25	<30	≥30-<35	≥35-<40	≥ 40
5M-2J	20	<25	≥25-<30	≥30-<35	≥35
2-3J	18	<23	≥23-<28	≥28-<33	≥33
3-7J	15	<20	≥20-<25	≥25-<30	≥30
7-14J	10	<15	≥15-<20	≥20-<25	≥25

More information available:

Tönnis D.: Roentgen studies and arthrography of the hip joint in infancy (1997) 9-58.

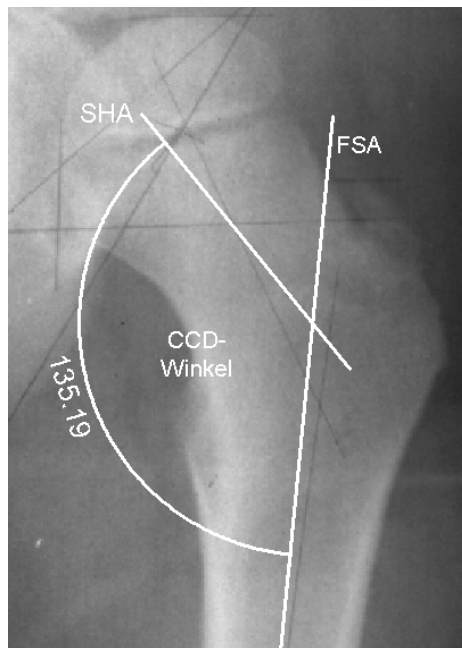
Neidel J., Tönnis D.: Percentile graphs in the documentation of acetabular angle in children with hip dysplasia. A tool in the diagnosis and quality control of its treatment (1994) 132 (6): 512-5.

CCD-angle

The CCD angle (Center-Collum-Diaphysis angle) is the angle between the femoral neck axis and the femoral shaft axis. It is used to exclude coxa vara/coxa valga from the diagnosis:

Coxa valga = steep CCD angle

Coxa vara = shallow CCD angle



FSA: femoral shaft axis

SHA femoral neck axis

Hip index

The hip index according to Busse, Gasteiger and Tönnis is a measure of pathological deviations of ACE, ACM and MZ.

The hip index can only be used for patients from five years of age for evaluation purposes. In younger patients the developmental variations are so pronounced that reliable statistical evaluation is impossible.

The hip index is calculated using the following dimensions:

ACE angle

ACM angle

MZ = decentralized distance line

$$\text{HIP INDEX (HW)} = A+B+C+10$$

$$A = \sqrt{3} \frac{\text{measured ACM} - \text{Mean of ACM}}{\text{Mean variation of ACM}}$$

$$B = \sqrt{3} \frac{\text{Mean of ACE} - \text{measured ACE}}{\text{Mean variation of ACM}}$$

$$C = \sqrt{3} \frac{\text{measured MZ} - \text{Mean of MZ}}{\text{Mean variation of MZ}}$$

Age	Angle	Mean	Mean variation
5-8 J.	ACM	45,8	2,7
	ACE	24,7	6,3
	MZ	3,2	1,7
9-12 J.	ACM	45,0	2,4
	ACE	31,1	5,0
	MZ	3,2	1,5 ¹
13-16 J.	ACM	45,6	2,8 ²
	ACE	34,3	5,7
	MZ	3,1	1,5
17-20 J.	ACM	44,6	3,0
	ACE	35,1	5,4
	MZ	3,6	1,5
> 21 J.	ACM	44,9	3,1 ³
	ACE	35,8	6,4 ⁴
	MZ	3,8	1,7

1. Values based on Brustel, Hepp, Tönnis
2. Values taken from the orthopedic accident surgery archives 1972
3. Further information can be found in
Busse J., Gasteiger W., Tönnis D.: Significance of the "summarized hip factor" in the diagnosis and prognosis deformed hip joints (1972) 72 (3): 245-52
4. Values taken from the orthopedic accident surgery archives 1972

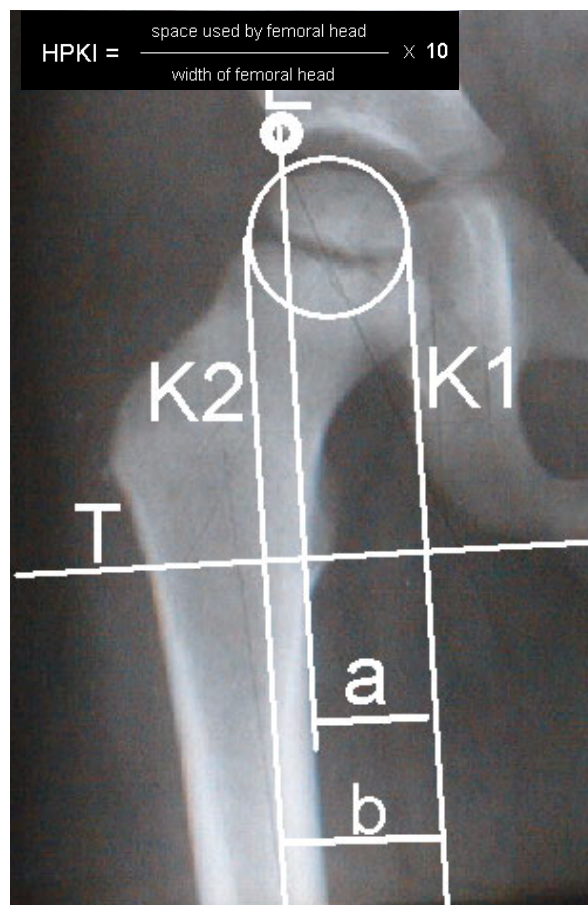
HPKI = acetabulum-femoral head index

according to Heymann and Herndorn

The acetabulum-femoral head index according to Heymann and Herndorn is a measure of the diameter of the femoral head and the degree of development of the acetabulum. If the femoral head is covered sufficiently on all sides by the acetabulum, the hip joint can develop normally with the acetabulum and femoral head forming a unit.

- a space used by femoral head
- b width of femoral head

$$\text{HPKI} = \frac{\text{space used by femoral head}}{\text{width of femoral head}} \times 10$$



E: acetabulum convexity

T: tangent to ischial bone

K1/K2: tangents to the femoral head circle (perpendicular to tangent to ischial bone)

a: space taken up by femoral head in acetabulum

b: width of femoral head

Evaluation

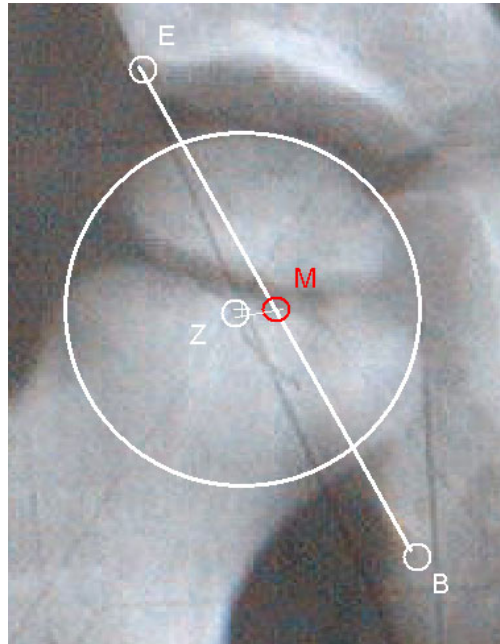
The HPKI should be within a range of 70—90. An HPKI of 90 is regarded as an acceptable normal value.

MZ Decentralized distance line

The decentralized distance line MZ is the distance between the femoral head center (Z) and the half-way point on the line running from the acetabulum convexity to the most caudal point of the acetabulum floor (M).

In the hip joint of a healthy adult $M = Z$.

The decentralized line is required to, for example, calculate the hip index according to Busse.



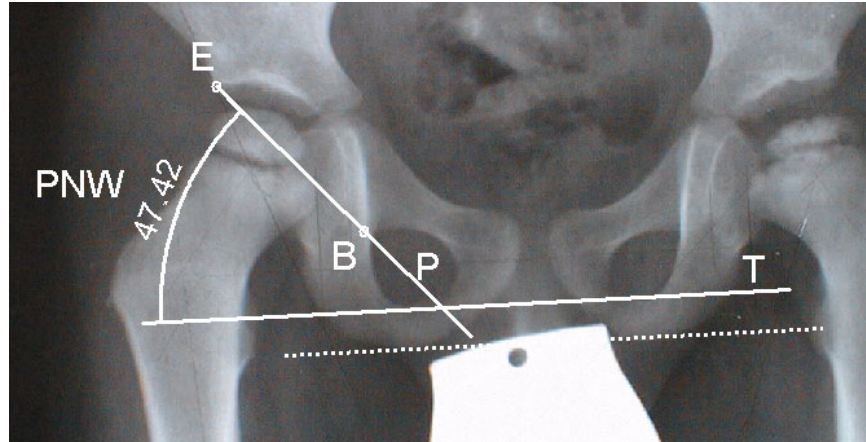
- E: Acetabulum convexity
- B: most caudal point of acetabulum edge
- M: point half-way between E and B
- Z: center of femoral head

PNW acetabular inclination angle

according to Ullmann

The acetabular inclination angle according to Ullmann measures the degree to which the acetabulum opens up or is inclined with respect to the Hilgenreiner line.

It is the angle between the ischial bone tangent (T) and a line (P) running through the acetabulum convexity (E) and the lowest point of the tear drop (B).



E: acetabulum convexity

B: lowest point of the tear drop


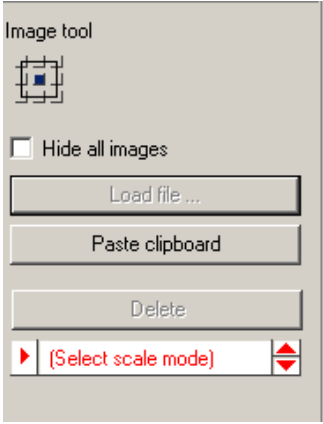
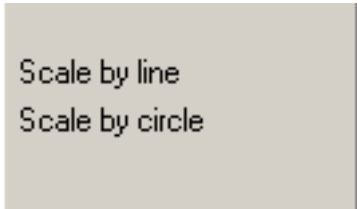
P: line through E and B

T: ischial bone tangent (parallel to the Hilgenreiner line)

Evaluation

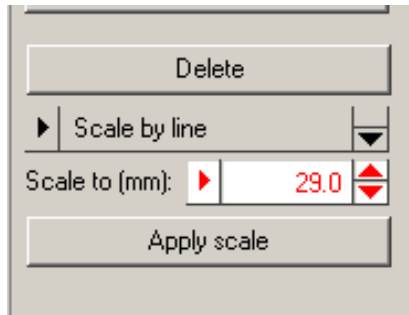
Age	Normal value Mean	Grade 1 Normal	Grade 2 slightly pathological.	Grade 3 gravely pathological.	Grade 4 extremely pathological.
1-10J.	46	≤ 49	50-52	53-55	≥ 56
11-12J.	44	≤ 47	48-51	52-54	≥ 55
13-14J	42	≤ 45	46-49	50-52	≥ 53
>14	40	≤ 43	44-46	47-49	≥ 50

Procedure

 <p>Step 1 Select image 1</p> <p>Select and insert the image and scale it.</p>	
<p>L: Select image to move or to scale R: Exit function M: Element or Line</p> <p>T:\mediCAD\bilder\perthes\Bild16.bmp</p> <p>L ● To take the image and position it, use the left mouse button. R To exit the function, use the right mouse button. M Not relevant</p>	
<p>Image tool</p>  <p>The function Select scale mode is activated and flashes.</p> <p>Select the scale mode and scale the image with the reference, which is visible on the screen.</p>  <p>Scale with the aid of a distance line if a scale bar is visible on the screen.</p> <p>Scale with the aid of a circle by 3 points if a scaling sphere is visible on the screen.</p> <p>L: 1. Point R: Cancel scaling M: Free</p> <p>L ● To define the first point of a line or the edge of a circle, use the left mouse button. R To exit the function, use the right mouse button. M Define the position of the point Free of your choice.</p> <p>L: 2. Point R: Back M: Free</p>	<p>Step 2 Select scale mode 2</p>
<p>L ● To define the second point of a line or the edge of a circle, use the left mouse button. R To return to the first point, use the right mouse button. M Define the position of the point Free of your choice.</p> <p>If you scale with the aid of a line, scaling now is done, confirm with Enter. If you scale with the aid of a circle complete the circle with the third point.</p> <p>L: 3. Point R: Back M: Free</p> <p>L ● To define the third point of the edge of a circle, use the left mouse button. R To return to the first point, use the right mouse button. M Define the position of the point Free of your choice.</p>	

Step 3 Scaling measurement in mm **3**

Fill in the correct measurement of the reference and confirm with **Apply scale** or **Enter**.



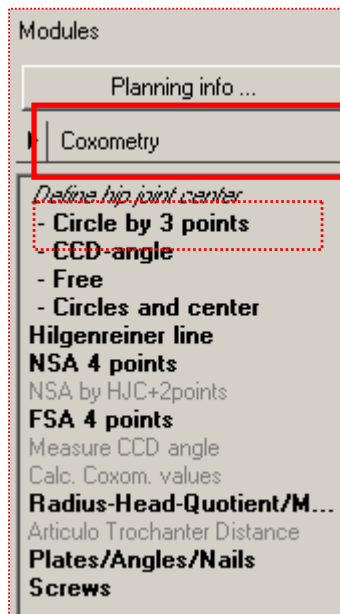
Warning: You can only scale the image correctly if a scale bar or a scaling sphere was placed in the image area while the image was exposed. Check your measurements carefully. False values can have serious consequences for the patient regarding misinterpretations of the right prostheses size.

Note:

After you scaled the image correctly, press the right mouse button to exit the function.



The image is now scaled 1:1 and you start with planning.

Step 4 Select module **4**

Choose the required module to work with.

The **Coxometry Module** is activated. You can exit this module at any time to select another module.

By activating the next steps of the menu you get automatically into the right function tool and are guided by the **Information bar**.

The support given by the **Information bar** is described next.

Step 5 Define hip joint center(HJC) **5**

Define hip joint center

- Circle by 3 points
- CCD-angle
- Free
- Circles and center

Requirements: A scaled image.

Result: The hip joint center can be defined by different functions:

Circle by 3 points: for a description, refer to **Hip-or knee Module**

CCD angle: for a description, refer to **Hip Module**

Free: for a description, refer to **HipModule**

or

Circles and center :

The hip joint center is displayed.

You are in the **Module tool**.



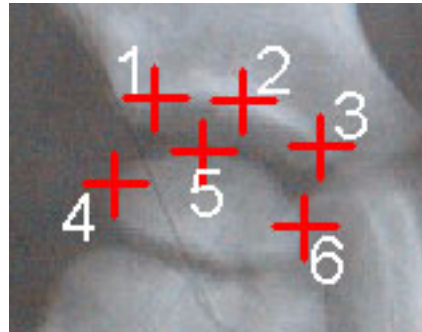
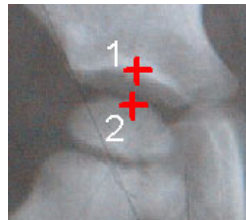
You are in the function **Circles and centers**. After you select the kind, color, and size of the line, define two or more point on the femoral head or on the edge of the acetabulum. A circular template is drawn for every point. Circular templates are opened around the same center point (mouse position) Use the mouse to move the circles so that one circle outline coincides with the acetabulum and another with the femoral head.



L: 1. edge point
R: Exit function
M: Free

HJC by circles

- L** • To define a distinct first point on the edge of the acetabulum, use the left mouse button.
- R** To finish the selection of points and draw one single circle around center, use the right mouse button. With the next click on the right mouse button you return to the **Module tool**.
- M** Define the position of the point **Free** of your choice.



L: 5. edge point
R: Finish selection
M: Free

HJC by circles

- L** • To define two or more points at the femoral head or at the edge of the acetabulum, use the left mouse button.
- R** • To finish the selection of points, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

A circular template is drawn for every point.

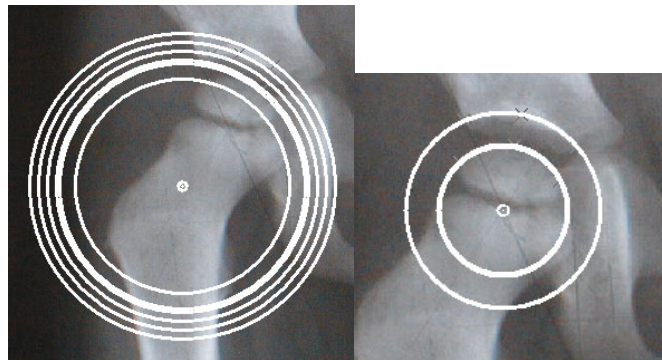
Move the mouse to place two coincidental circles.



L: Place
R: Exit function
M: Free

HJC by circles

- L** • To move the circles the way that one circle coincides with the acetabulum and another circle as good as possible with the femoral head, use the left mouse button.
- R** To return to the **Module tool**, use the right mouse button.
- M** Define the position of the point **Free** of your choice.



The hip joint center is displayed, the circles fade out.

Step 6 Draw tangent to ischial bone **6**

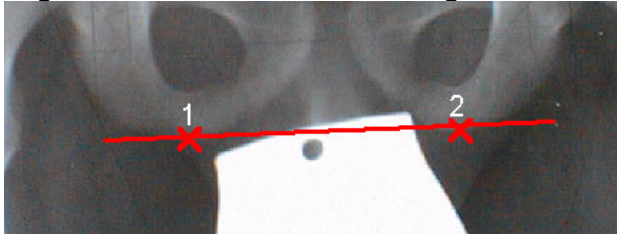
Circles and center

Hilgenreiner's line

FNA by 4 points

Requirements: A scaled image and a hip joint center
Result: The tangent to ischial bone is drawn. It serves as reference line for further calculations. If you do not draw that line, you are requested to draw it if necessary.

Hilgenreiner line = Ischial bone tangent



You are in the **Joint/Axis Tool**, the function **Hilgenreiner line** is activated.

<ul style="list-style-type: none"> L: Define 1. of 2 points R: Exit function M: Free 	Hilgenreiner's line (e.g. ischial bone tangent)
--------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------

L ● To place the starting point (point 1), use the left mouse button.

R To return to the **Module tool**, use the right mouse button.

M Define the position of the point **Free** of your choice.

<ul style="list-style-type: none"> L: Define 2. of 2 points R: Back M: Free 	Hilgenreiner's line (e.g. ischial bone tangent)
-----------------------------------------------------------------------------------------------------------------	----------------------------------------------------

L ● To place the end point (point 2), use the left mouse button.

R To return to point 1, use the right mouse button.

M Define the position of the point **Free** of your choice.

The Hilgenreiner-Line is drawn.

Step 7 Define femoral neck axis **7**

Hilgenreiner's line

FNA by 4 points

FNA by HJC+2points

FSA by 4 points

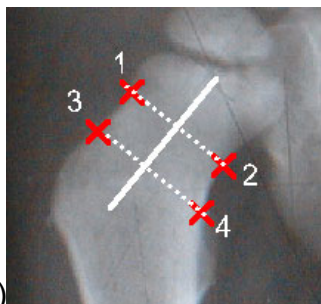
Measure CCD angle

Requirements:

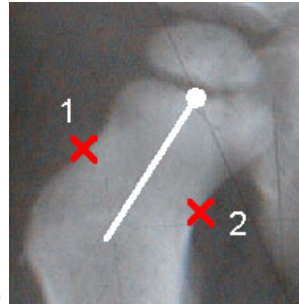
A) To define the axis by four points only a scaled image is necessary.

B) To define the axis by two points a scaled image with the hip joint center is necessary.

Result: The femoral neck axis is drawn.



see A)



see B)

Description for A)

Activate the function ***Femoral neck axis by 4 points.***

	L: Define 1. of 4 points R: Exit function M: Free	FNA by 4 points
--	---------------------------------------------------------	-----------------

- L ●** To define the first point (1), use the left mouse button.
- R** To return to the ***Module tool***, use the right mouse button.
- M** Define the position of the point ***Free*** of your choice.

	L: Define 2. of 4 points R: Back M: Free	FNA by 4 points
--	------------------------------------------------	-----------------

- L ●** To define the second point (2), use the left mouse button.
- R** To return to point 1, use the right mouse button.
- M** Define the position of the point ***Free*** of your choice.

	L: Define 3. of 4 points R: Back M: Free	FNA by 4 points
--	------------------------------------------------	-----------------

- L ●** To define the third point (3), use the left mouse button.
- R** To return to point 2, use the right mouse button.
- M** Define the position of the point ***Free*** of your choice.

	L: Define 4. of 4 points R: Back M: Free	FNA by 4 points
--	------------------------------------------------	-----------------

- L ●** To define the fourth point (4), use the left mouse button.
- R** To return to point (3), use the right mouse button.
- M** Define the position of the point ***Free*** of your choice.

The femoral neck axis is automatically displayed.

Description for B)

Activate the function ***Femoral neck axis by the Hip joint center+2 points***

	L: Define 1. of 2 points R: Exit function M: Free	FNA by HJC+2points
--	---------------------------------------------------------	--------------------

- L ●** To define the first point (1), use the left mouse button.
- R** To return to the ***Module tool***, use the right mouse button.
- M** Define the position of the point ***Free*** of your choice.

After you placed point 1, the femoral neck axis is shown attached to the mouse pointer. The final position changes according to the position of the second point (2).

	L: Define 2. of 2 points R: Back M: Free	FNA by HJC+2points
--	------------------------------------------------	--------------------

- L ●** To define the second point (2), use the left mouse button.
- R** To return to point 1, use the right mouse button.
- M** Define the position of the point ***Free*** of your choice.

After you have positioned the second point, the femoral neck axis is shown.

Step 8 Define femoral shaft axes by 4 points **8**

FNA by HJC+2points

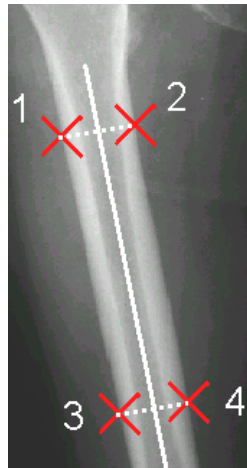
FSA by 4 points

Measure CCD angle

Calculate coxo. values

Requirements: A scaled image.

Result: After you have placed four points the femoral shaft axis is shown.



You activate the function FSA by four points. You are in the function **Joint/axis tool**.

	L: Define 1. of 4 points R: Exit function M: Free	FSA by 4 points
--	---------------------------------------------------------	-----------------

- L ●** To define the first of 4 points (1), use the left mouse button.
- R** To return to the **Module tool**, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

	L: Define 2. of 4 points R: Back M: Free	FSA by 4 points
--	------------------------------------------------	-----------------

- L ●** To define the second of 4 points (2), use the left mouse button.
- R** To return to point 1, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

	L: Define 3. of 4 points R: Back M: Free	FSA by 4 points
--	------------------------------------------------	-----------------

- L ●** To define the third of 4 points (3), use the left mouse button.
- R** To return to point 1, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

	L: Define 4. of 4 points R: Back M: Free	FSA by 4 points
--	------------------------------------------------	-----------------

- L ●** To define the fourth of 4 points (4), use the left mouse button.
- R** To return to point 1, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

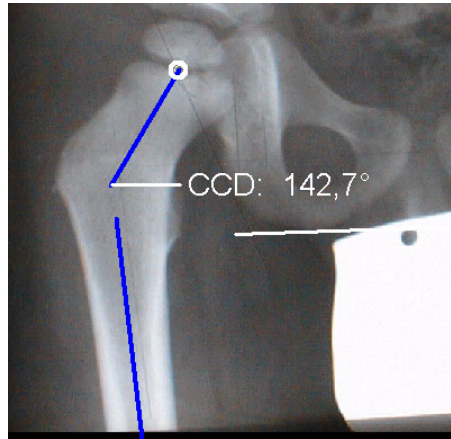
The femoral shaft axis is drawn.

Step 9 Define CCD angle **9**

FSA by 4 points
Measure CCD angle
 Calculate coxo. values
 Radius-Head-Quotient/Mos...

Requirements: Femoral neck axis and femoral shaft axis are shown.

Result: The CCD angle is automatically shown.



L: Place
 R: Exit function
 M: Free

Measure CCD angle

- L ●** To place the text of the automatically calculated angle attached to the mouse pointer on the desired position, use the left mouse button.
- R** To return to the **Coxometry tool**, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The CCD angle is shown.

Step 10 Calculate the coxometric values **10**

Measure CCD angle
 Calculate coxo. values
 Radius-Head-Quotient/Mos...

Requirements: HJC and tangent to ischial bone are shown.

Result: After you placed the required points, all values are calculated and subsequently shown in a chart. For more information about the basics for the calculation and measurements, refer to **Basics Coxometry**.

Warning:

Check all items carefully, false information may cause severe problems.

The following details must be filled in here:

Physicians name

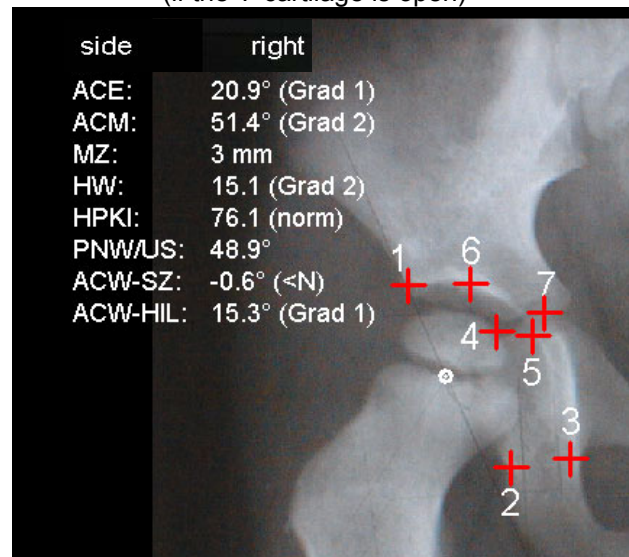
Patients name

Patients date of birth

Recording date of the image

Abbreviations:

ACE	angle according to Wiberg/CE-angle
ACM	angle according to Idelberger and Frank
MZ	decentralized distance line used to calculate the hip index
HW	hip index according to Busse, Gasteiger and Tönnis
HPKI	acetabulum-femoral head index according to Heymann and Herndorn
PNW/US	acetabular inclination angle according to Ullmann
ACW-SZ	acetabular angle (angle of sclerotic area of the roof of the acetabulum if the Y-cartilage is closed)
ACW-HL	acetabular angle according to Hilgenreiner (if the Y-cartilage is open)



	L: Laterocranial acetabular edge R: Exit function M: Free	Calculate coxo. values
L ● R M	To place the first point on the laterocranial acetabulum edge (1), use the left mouse button. To return to the Coxometry module , use the right mouse button. Define the position of the point Free of your choice.	
	L: Mediocaudal acetabular edge R: Back M: Free	Calculate coxo. values
L ● R M	To place the second point (2) on the mediocaudal acetabular edge, use the left mouse button. To return to point 1, use the right mouse button. Define the position of the point Free of your choice.	
	L: Caudales point of tear drop R: Back M: Free	Calculate coxo. values
L ● R M	To place the third point (3) on the caudal tear drop, use the left mouse button. To return to point 2, use the right mouse button. Define the position of the point Free of your choice.	
	L: Hip head edge R: Back M: Free	Calculate coxo. values
L ● R M	To place the fourth point (4) on the cranial sclerotic area, use the left mouse button. With the circle attached to the mouse pointer try to coincide the edge of the joint head as accurately as possible. To return to point 3, use the right mouse button. Define the position of the point Free of your choice.	
	L: Acetabular bottom R: Back M: Free	Calculate coxo. values
L ● R M	To place the fifth point (5) on the bottom of the acetabulum, use the left mouse button. To return to point 4, use the right mouse button. Define the position of the point Free of your choice.	
Note: You can skip the next point (6) if the Y-cartilage is still open. To skip, press Space key .		
	L: Medial sclerotic zone R: Back M: Free	Calculate coxo. values Press space to skip this point (AC-SzW. will not be measured)
L ● R M	To place the sixth point (6) on the medial edge of the sclerotic area, use the left mouse button. To return to point 5, use the right mouse button. Define the position of the point Free of your choice.	
Note: You may skip the next point (7) if the Y-cartilage closed. To skip press Space key .		
	L: Y-cartilage R: Back M: Free	Calculate coxo. values Press space to skip this point (AC-Hilg will not be measured)
L ● R M	To place the seventh point (7) within the Y-cartilage, use the left mouse button. To return to point 1, use the right mouse button. Define the position of the point Free of your choice.	
All values and graduations are shown on the screen.		

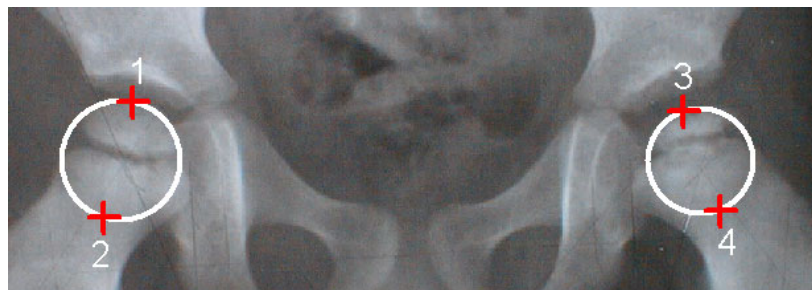
Step 11 Calculate Radius-head-quotient/Mose Index **11**

Calculate coxo values
Radius-Head-Quotient/Mos..
 Articulo trochanter distance
 Plates/Angles/Nails

Requirements: A scaled image
Result: Following values are calculated and automatically displayed:

1. **Radius left (body side)** in mm
2. **Radius right (body side)** in mm
3. **Coxa magna ratio**, this is the quotient of the left hip head to the right hip head.
4. **Mose Index:** is the difference between the greater and the smaller radius divided by the greater radius.

(for more information, refer to **Basics** Coxometry)



Draw a circle which fits as exactly as possible in the hip joint capsule.

	L: 1. of 2 points on right hip head edge R: Exit function M: Free	Radius-Head-Quotient/Mose-Index
--	-------------------------------------------------------------------------	---------------------------------

- L** ● To start a circle around the right hip head (1), use the left mouse button.
- R** To return to the **Coxometry Tool**, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

Use the mouse to drag open the circle.

	L: 2. of 2 points on right hip head edge R: Back M: Free	Radius-Head-Quotient/Mose-Index
--	----------------------------------------------------------------	---------------------------------

- L** ● To complete the circle (2), use the left mouse button.
- R** To return to point 1, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The first circle is shown.

	L: 1. of 2 points on left hip head edge R: Back M: Free	Radius-Head-Quotient/Mose-Index
L ● R M	To start a circle around the left hip head (1), use the left mouse button. To return to point 2 of the right circle, use the right mouse button. Define the position of the point Free of your choice.	
The calculation is already shown. The Values are still changing while the mouse is moved and the size of the circle is not yet fixed.		
	L: 2. of 2 points on left hip head edge R: Back M: Free	Radius-Head-Quotient/Mose-Index
L ● R M	To complete the circle (2), use the left mouse button. To return to point 1 of the left circle, use the right mouse button. Define the position of the point Free of your choice.	
Both circles and the calculation are shown.		

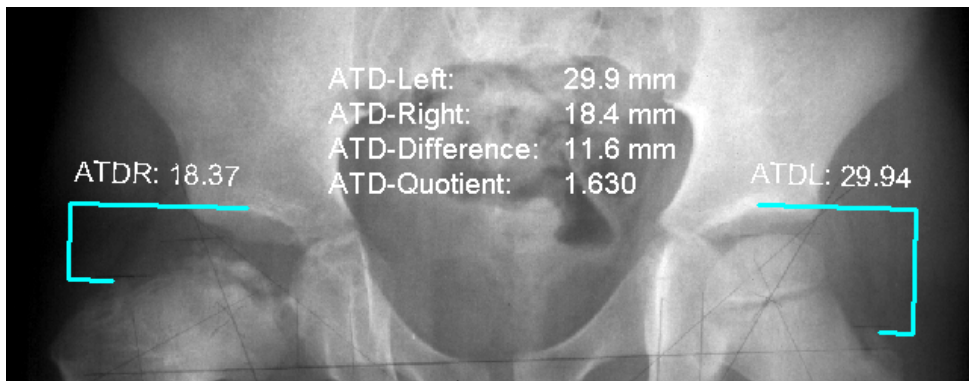
Step 12 Calculate Articulo Trochanter Distance (Leg Length difference) **12**

Radius:Head-Quotient/Mose-Index
Articulo trochanter distance
 Plates/Anoles/Nails
 Screws

Requirements: A scaled image and the Ischial bone tangent

Result: The following result are shown automatically:

Distances Trochanter major to Acetabular edge left body side
 Trchanter major to Acetabular edge right body side
Differences Between distances (refer to above), which indicates the leg length difference
Quotient: of both distances.



L: Select right greater trochanter
 R: Exit function
 M: Free
 Articulo trochanter distance

- L ●** To place the mouse pointer on the right Trochanter major laterocranial, use the left mouse button.
- R** To return to the **Coxometry Tool**, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

L: Select right acetabular roof
 R: Back
 M: Free
 Articulo trochanter distance

- L ●** To place the mouse pointer on the right, cranial acetabulum edge, use the left mouse button.
- R** To return to the right Trochanter major, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

L: Select right greater trochanter
 R: Exit function
 M: Free
 Articulo trochanter distance

- L ●** To place the mouse pointer on the left Trochanter major laterocranial, use the left mouse button.
- R** To return to the right, cranial acetabulum edge, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

Subsequently the result is shown. It changes with the movements of the mouse.

L: Select right acetabular roof
 R: Back
 M: Free
 Articulo trochanter distance

- L ●** To place the mouse pointer on the left, cranial acetabulum edge, use the left mouse button.
- R** To return to the left Trochanter major, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

All results are shown.

1

Osteotomy I

Basics

With the module Osteotomy you are able to plan femoral or tibial corrections of deformities. The main interest in corrective osteotomies of the lower extremity is to realign the mechanical axis and joint orientation lines. Biomechanical loading forces on the joints are brought into physiological range to prevent early joint degeneration.

The physician deciding on an osteotomy rather than on an endoprosthesis receives with the tool help to plan the Osteotomy. Depending on the malposition of axes he decides on an osteotomy of the proximal or distal femur/tibia or an intertrochanteric osteotomy.

Even one or two tibial or femoral osteotomies are possible.

The size of the correction angle is calculated either automatically by the Orthopaedic Application regarding the optimal position of axes or by the physician. He can define all angles and results by manual interactions.

A comfortable choice of required nails, plates or screws is offered by a database.

Note:

You cannot correct axes malpositions on an image showing part of the leg.

An image of the whole leg in a standing position can be composed from several images showing part of the leg.

For more information about exporting and composing images, refer to ***Baics– Loading images*** at the beginning of this manual.

Loading images to the Orthopaedic Application

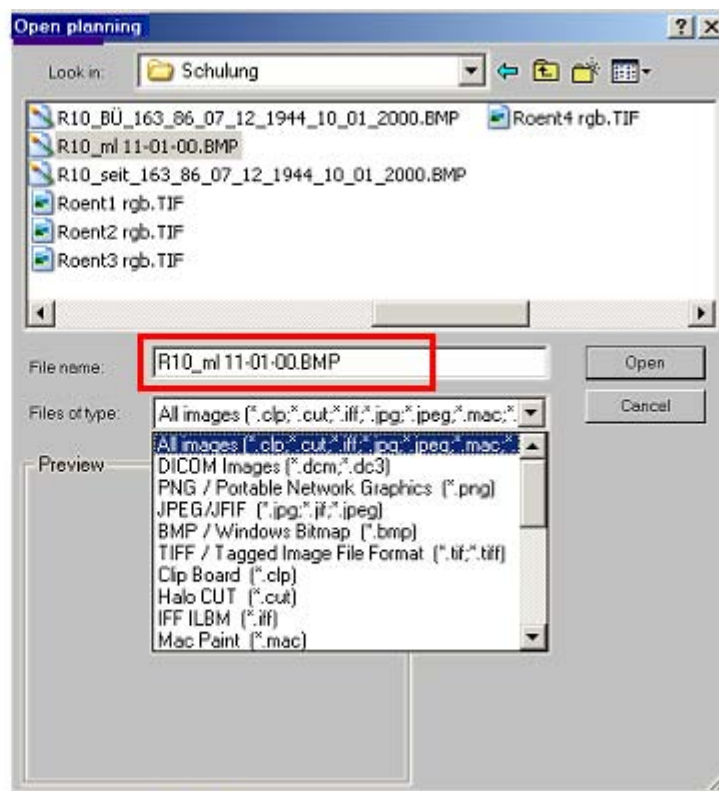
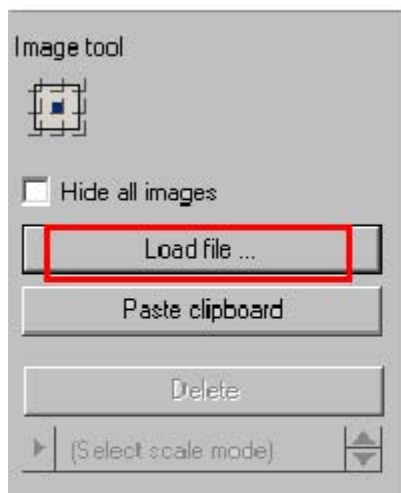


The following steps are necessary:

1. Activate the function **Images** to load and to scale an image.
2. Select the first image from where it is stored. Regard the right file format.
3. The Orthopaedic Application prompts you to **scale** the image. Continue the process until all of the individual images you want to compose are loaded in the Orthopaedic Application.

NOTE: The larger you display the reference scale during scaling, the more precisely you can assemble the individual image later.

4. Click on the images, one after the other, and move it to the required position. Continue doing this until the images have been correctly positioned.
5. Save the resulting intermediate image temporarily as an Orthopaedic Application planning file **.mpl** to your local hard disk.



Warning:





Any axial malalignment can only be calculated correctly if the images used for planning satisfy the following requirements:










A-P image showing one leg only (taken of both legs) or showing both legs in a standing position with equal load.

Hip joint and ankle joint visible in full.

A lead scale is shown on the image (or each part of the image to be supposed to planning) at the height of the longitudinal axes of femur or tibia for calibration purposes.

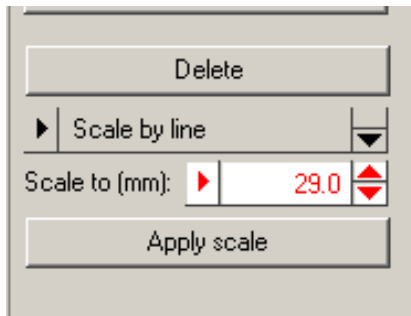
Procedure

 <p>Select the image and scale it.</p> <p>OR</p>  <p>Select an image that is already complete and scaled. In this case Steps 2 + 3 are not necessary.</p>	<p>Step 1 Select image 1</p>
 <p>L: Select image to move or to scale R: Exit function M: Element or Line</p> <p>L ● To take the image and position it, use the left mouse button. R To exit the function, use the right mouse button. M Not relevant.</p>	
<div data-bbox="256 619 578 1037" style="border: 1px solid gray; padding: 5px;"> <p>Image tool</p>  <p><input type="checkbox"/> Hide all images</p> <p>Load file ...</p> <p>Paste clipboard</p> <p>Delete</p> <p>▶ (Select scale mode) ▼</p> </div> <div data-bbox="690 800 1047 1003" style="border: 1px solid gray; padding: 10px; margin: 10px 0;"> <p>Scale by line</p> <p>Scale by circle</p> </div> <p>The function Select scale mode is activated and flashes.</p> <p>Select the scale mode and scale the image with the reference, which is visible on the screen.</p> <p>Scale with the aid of a distance line if a scale bar is visible on the screen.</p> <p>Scale with the aid of a circle by 3 points if a scaling sphere is visible on the screen.</p>	<p>Step 2 Select scale mode 2</p>

 L: 1. Point  R: Cancel scaling  M: Free	T:\mediCAD\bilder\perthes\Bild16.bmp
<p>L ● To define the first point of a line or the edge of a circle, use the left mouse button.</p> <p>R To exit the function, use the right mouse button.</p> <p>M Define the position of the point Free of your choice.</p>	
 L: 2. Point  R: Back  M: Free	T:\mediCAD\bilder\perthes\Bild16.bmp
<p>L ● To define the second point of a line or the edge of a circle, use the left mouse button.</p> <p>R To return to the first point, use the right mouse button.</p> <p>M Define the position of the point Free of your choice.</p>	
<p>If you scale with the aid of a line, scaling now is done, confirm with Enter If you scale with the aid of a circle complete the circle with the third point.</p>	
 L: 3. Point  R: Back  M: Free	T:\mediCAD\bilder\perthes\Bild16.bmp
<p>L ● To define the third point of the edge of a circle, use the left mouse button.</p> <p>R To return to the first point, use the right mouse button.</p> <p>M Define the position of the point Free of your choice.</p>	

Step 3 Scaling measurement in mm **3**

Fill in the correct measurement of the reference and confirm with **Apply scale** or **Enter**.



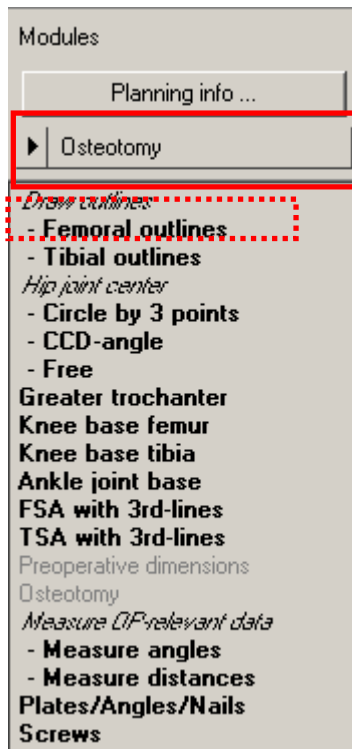
Warning: You can only scale the image correctly if a scale bar or a scaling sphere was placed in the image area while the image was exposed. Check your measurements carefully. False values can have serious consequences for the patient regarding misinterpretations of the right prostheses size.

Note:

After you scaled the image correctly press the right mouse button to exit the function.



The image is now scaled 1:1 and you can start planning.

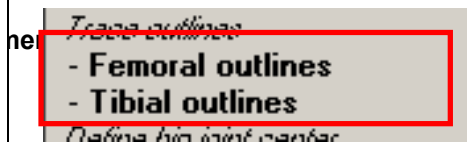
Step 4 Select module **4**

Choose the required module to work with.

The **Osteotomy I** is activated. You can exit this module at any time to select another module

By activating the next steps of the menu you get automatically into the right function tool and are guided by the **Information bar**.

The support given by the **Information bar** is described next.

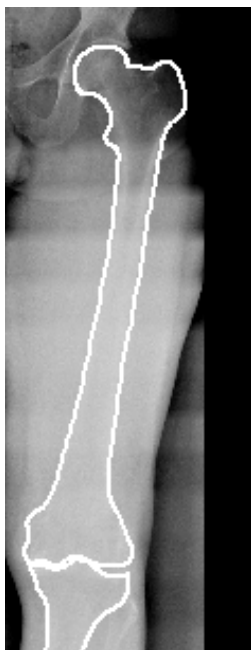
Step 5 Trace outlines **5**

Requirements: A scaled image of a long leg.

Result: The femoral and the tibial outline are drawn by individual points along the outer corticalis.

You are in the function **Trace outlines**.

NOTE: Distinguish between femoral and tibial outline when activating the function in each case. If both outlines are drawn with the same function, a rotation of the femur against the tibia is **not** possible.



After you select the kind, color, and size of the line, click one point after the other, following the contour. The spline function requires less intermediate points for straight lines than for curves.
Note: To reject points, go to the function **Reject points** or press the backspace key (above return). You **reject last point** step by step and afterwards you continue drawing.

	L: first point R: Exit function M: Free	Contours
--	-----------------------------------------------	----------

- L●** To define the first point of the femur outline, use the left mouse button, for example, you start drawing the lateral outer corticalis.
- R** To exit the function, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

	L: next point R: next contour M: Free	Contours Press backspace to reject the last point
--	---------------------------------------------	------------------------------------------------------

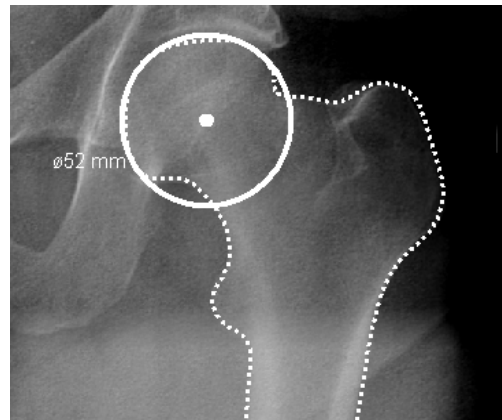
- L●** To define the next point of the outline, use the left mouse button.
- R** To finish the line, use the right mouse button.
- M** Define the position of the point **Free** of your choice.
- R●** With the second. mouse click you return to the **Module tool**.

You draw the outer corticalis of tibia the in the same way.

Step 6 Define hip joint center(HJC) **6**

Define hip joint center

- Circle by 3 points
- CCD-angle
- Free

Requirements: A scaled image.**Results:** A circle is drawn by 3 points, the circle and the diameter in mm temporary appears, the center point of the circle is defined and drawn.

You are in the function **Circle by 3 points (HJC)**. After you select the kind, color and size of the line, start drawing the circle.

	L: 1. Point R: Exit function M: Free	HJC by 3 points
--	--------------------------------------------	-----------------

- L** ● To define the first point on the edge of the hip head, use the left mouse button.
- R** To exit the function, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

	L: 2. Point R: Back M: Free	HJC by 3 points
--	-----------------------------------	-----------------

- L** ● To define the second point on the edge of the hip head, use the left mouse button.
- R** To return to point 1, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

	L: 3. Point R: Back M: Free	HJC by 3 points
--	-----------------------------------	-----------------

- L** ● To define the third point on the edge of the hip head, use the left mouse button.
- R** To return to point 1, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

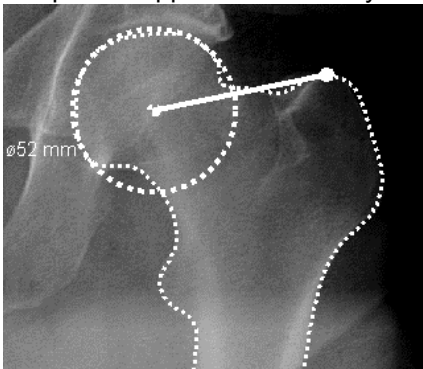
The hip joint center point is displayed.

Step 7 Select Trochanter Major **7**

Greater trochanter

~~Knee base femur~~

Requirements: A hip joint center is displayed.
Results: A connecting line between the hip joint center and the most cranial point of the greater trochanter is displayed. The direction of this line defines for the Orthopaedic Application the body side.



The function **Trochanter major** is activated.
 After you selected the kind, color and size of the line, start drawing the connecting line.
 The starting point is automatically the hip head center.

	L: Place greater trochanter R: Exit function M: Free	Greater trochanter
--	------------------------------------------------------------	--------------------

- L** ● To drag the line up to the most cranial point of the greater trochanter, use the left mouse button.
- R** To return to the **Module tool**, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The connecting line is drawn, the actual body side is defined.

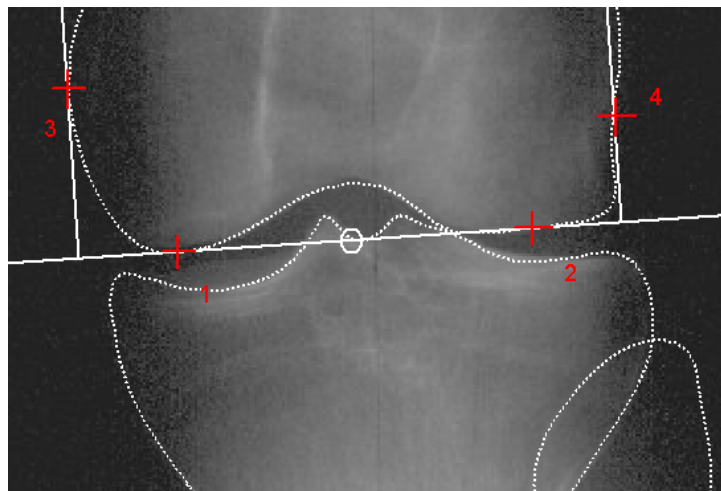
Step 8 Define femoral knee base **8**

Knee base femur

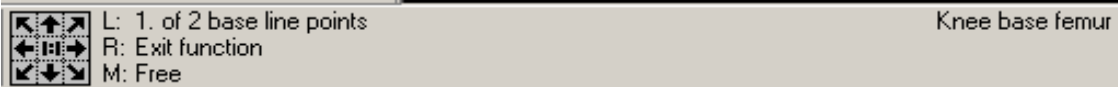
~~Knee base tibia~~

~~Ankle joint base~~

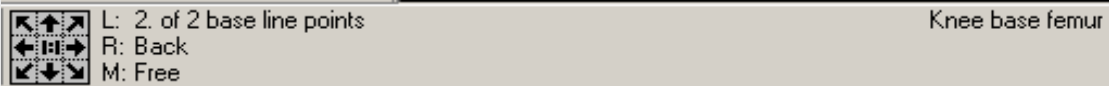
Requirements: Drawn femoral outline.
Results: The femoral joint base line is positioned and the femoral knee base center is automatically calculated by drawing two perpendicular lines that form a tangent to the lateral and medial femur condyles.



The function **Knee base femur** is activated. After you selected the kind, color and size of the line, start drawing the tangential line on the distal condyles (refer to the picture above point 1 and 2).

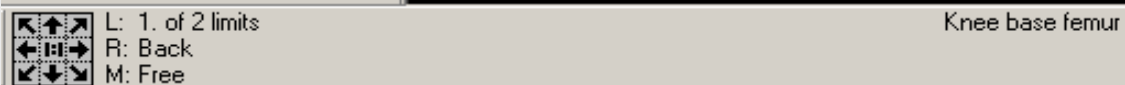


- L** ● To click on the first most distal point of the medial /lateral femoral condylus (refer to the picture above point 1), use the left mouse button.
- R** To return to the **Modules tool**, use the right mouse button.
- M** Define the position of the point **Free** of your choice.



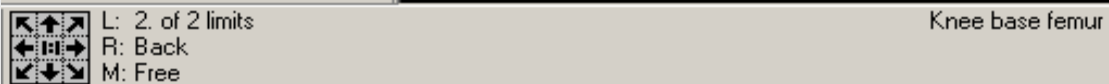
- L** ● To click on the second most distal point of the medial /lateral femoral condylus (refer to the picture above point 2), use the left mouse button.
- R** To return to point 1, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The femoral basic line is displayed. A perpendicular line automatically appears.



- L** ● Drag the mouse pointer upwards; move the perpendicular to a position where it forms a tangent to the lateral femur condylus (3) and click to confirm.
- R** To return to the second point of the basic line, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The knee base center already appears. It changes the position dependent on the movements of the mouse pointer. Finally, define the femoral knee base center in the middle of the distance of the first and the second perpendicular line.



- L** ● Drag the mouse pointer upwards; move the perpendicular to a position where it forms a tangent to the medial femur condylus (4) and click to confirm.
- R** To return to the first lateral tangent, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

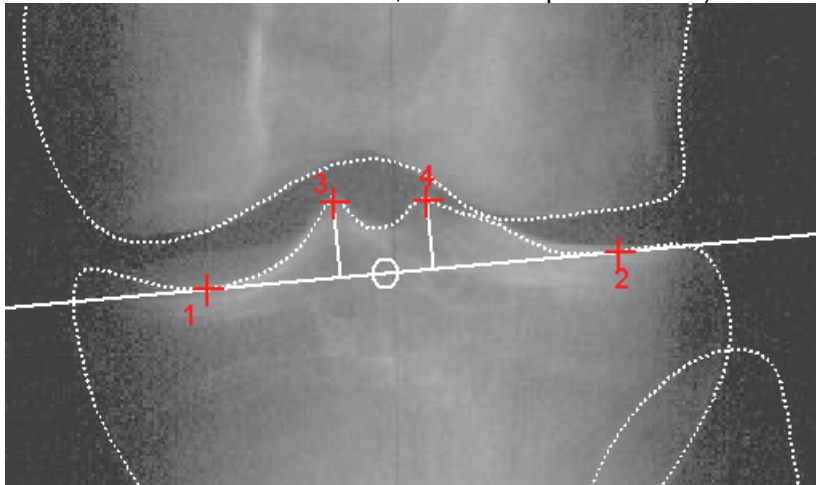
The femoral knee base line and the knee base center are displayed.

Step 9 Define tibial knee base **9**

- Knee base femur
- Knee base tibia**
- Ankle joint base

Requirements: Drawn femoral knee base.

Results: The tibial joint base line is positioned and the tibial knee base center is automatically calculated by drawing two perpendicular lines that form a tangent to the lateral and medial tibia condyles (alternatively you can use the eminentiae, refer to the picture below).



The function **Knee base tibia** is activated. After you select the kind, color and size of the line, start drawing the tangential line on the proximal tibial condyles (refer to the picture above point 1 and 2).

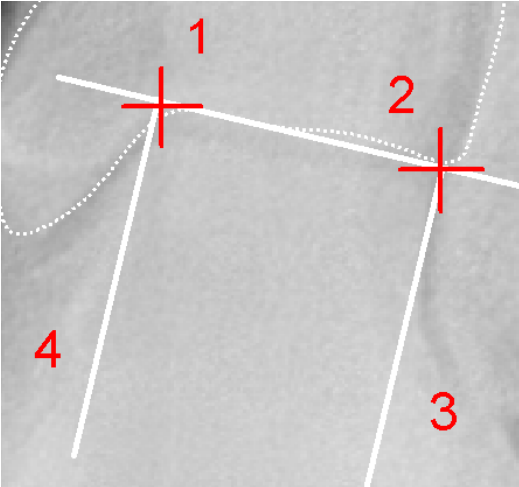
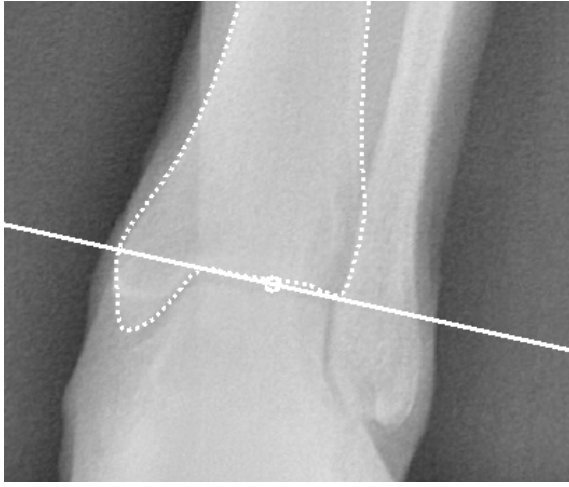
	L: 1. of 2 base line points	Knee base tibia
	R: Exit function	
	M: Free	

- L** ● To click on the first point of the medial /lateral tibial condylus (refer to the picture above point 1), use the left mouse button.
- R** To return to the **Modules tool**, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

	L: 2. of 2 base line points	Knee base tibia
	R: Back	
	M: Free	

- L** ● To click on the second point of the medial/lateral tibial condylus (refer to the picture above point 2), use the left mouse button.
- R** To return to point 1, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The tibial base line is displayed. A perpendicular line automatically appears.

<div style="border: 1px solid black; padding: 5px;"> <div style="float: right; text-align: right;">Knee base tibia</div> <div style="clear: both;"></div> <p>L: 1. of 2 limits R: Back M: Free</p> <p>L ● Drag the mouse pointer upwards; move perpendicular to a position where it forms a tangent to the lateral tibial condylus (3) /eminientia and click to confirm.</p> <p>R To return to the second point of the basic line, use the right mouse button.</p> <p>M Define the position of the point Free of your choice.</p> <p>The knee base center already appears. It changes the position dependent on the movements of the mouse pointer. Finally, define the tibial knee base center in the center of the distance between the first and the second perpendicular line.</p> </div>	
<div style="border: 1px solid black; padding: 5px;"> <div style="float: right; text-align: right;">Knee base tibia</div> <div style="clear: both;"></div> <p>L: 2. of 2 limits R: Back M: Free</p> <p>L ● Drag the mouse pointer upwards; move perpendicular to a position where it forms a tangent to the medial tibial condylus (4) /eminientia and click to confirm.</p> <p>R To return to the first lateral tangent, use the right mouse button.</p> <p>M Define the position of the point Free of your choice.</p> <p>The tibial knee base line and the knee base center are displayed.</p> </div>	
<p>Step 10 Define ankle joint base 10</p>	
<div style="border: 1px solid black; padding: 10px;"> <div style="border: 2px solid red; padding: 2px; display: inline-block;"> <p>Knee base tibia</p> <p>Ankle joint base</p> <p>FSA with 3th-lines</p> </div> <div style="margin-left: 20px;"> <p>Requirements: The hip joint center (HJC), femoral and tibial knee base center are defined.</p> <p>Results: The ankle joint basic line and the center are displayed.</p> <p>The function Ankle joint base is activated.</p> </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 20px;">   </div>	

You are in the function **Ankle joint base**.
 After you select the kind, color, and size of the line, start drawing the tangential line from point 1 to point 2.

	L: 1. of 2 base line points R: Exit function M: Free	Ankle joint base
--	------------------------------------------------------------	------------------

- L** ● To click on the first point distal of the distal tibial base (refer to the picture above point 1), use the left mouse button.
- R** To return to the **Modules tool**, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

	L: 2. of 2 base line points R: Back M: Free	Ankle joint base
--	---------------------------------------------------	------------------

- L** ● To click on the second point distal tibial base (refer to the picture above point 2), use the left mouse button.
- R** To return the first point, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The ankle joint basic line is displayed. A perpendicular line appears automatically

	L: 1. of 2 limits R: Back M: Free	Ankle joint base
--	-----------------------------------------	------------------

- L** ● Drag the mouse pointer upwards; move perpendicular to a position where it forms a tangent to the talus (point 3) and click to confirm.
- R** To return to the second point of the basic line, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The ankle joint center already appears. It changes the position dependent on the movements of the mouse pointer. Finally you define the ankle joint center in the center of the distance between the first and the second perpendicular line.

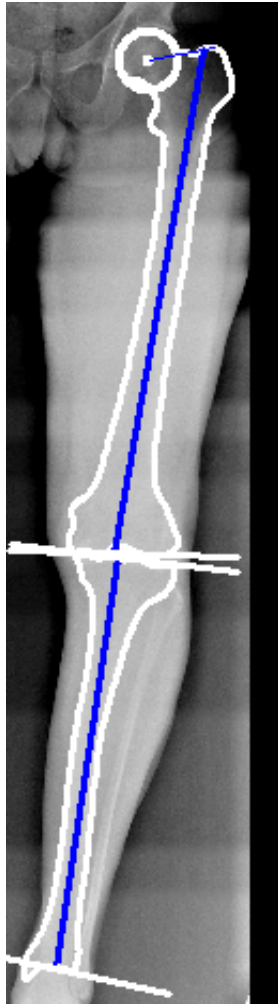
	L: 2. of 2 limits R: Back M: Free	Ankle joint base
--	-----------------------------------------	------------------

- L** ● Drag the mouse pointer upwards; move perpendicular to a position where it forms a tangent to the talus (point 4) and click to confirm.
- R** To return to the first lateral tangent, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The base line and the ankle joint center are displayed.

Step 11 Define anatomical shaft axes **11**

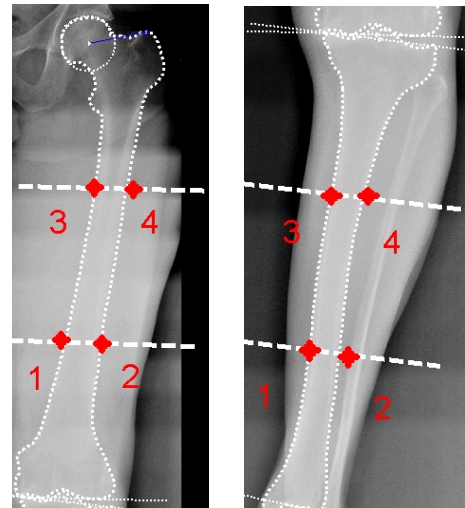
ankle joint base
FSA with 3rd-lines
TSA with 3rd-lines
 Preoperative knee dimension



Requirements: All joint centers are defined as hip-, knee-, and ankle joint.

Result: Both anatomical axes are shown in a preview on the screen as basic information about the actual, preoperative situation.

Two auxiliary lines in the upper and lower third of the femoral or tibial shaft divide the distance of the hip center to the femoral knee base center and the tibial knee base center to the ankle joint center into 3 identical parts.



FSA

TSA

You measure them out in pairs by selecting point 1-2 and 3-4. The anatomical axes are drawn automatically going through the center of the distances between the points.

You are in the function **FSA by 3rd lines**.

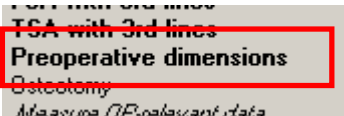
The procedure for both axes is the same.
 Select one of both functions and draw the first axis, afterwards the second. After you select the kind, color and size of the line define the points 1, 2, 3, and 4. The points 1, 2, 3, and 4 are intersection points of the third lines and the bone outline.
 You are in the **snap-to-point** mode.

	L: Define 1. of 4 points R: Exit function M: Element or Line	FSA with 3rd-lines
L ●	To click on the first point (1), use the left mouse button.	
R	To exit the function, use the right mouse button.	
M	Element or line is preinstalled as snap to function.	
	L: Define 2. of 4 points R: Back M: Element or Line	FSA with 3rd-lines
L ●	To click on the second point (2) , use the left mouse button.	
R	To exit the function, use the right mouse button.	
M	Element or line is preinstalled as snap to function.	
	L: Define 3. of 4 points R: Back M: Element or Line	FSA with 3rd-lines
L ●	To click on the third point (3), use the left mouse button.	
R	To exit the function, use the right mouse button.	
M	Element or line is preinstalled as snap to function.	
	L: Define 4. of 4 points R: Back M: Element or Line	FSA with 3rd-lines
L ●	To click on the fourth point (4) , use the left mouse button.	
R	To exit the function, use the right mouse button.	
M	Element or line is preinstalled as snap to function.	

The anatomical axis is drawn automatically.

Repeat this procedure in the same way for the tibial anatomical axis.

Step 12 Define preoperative dimensions 12



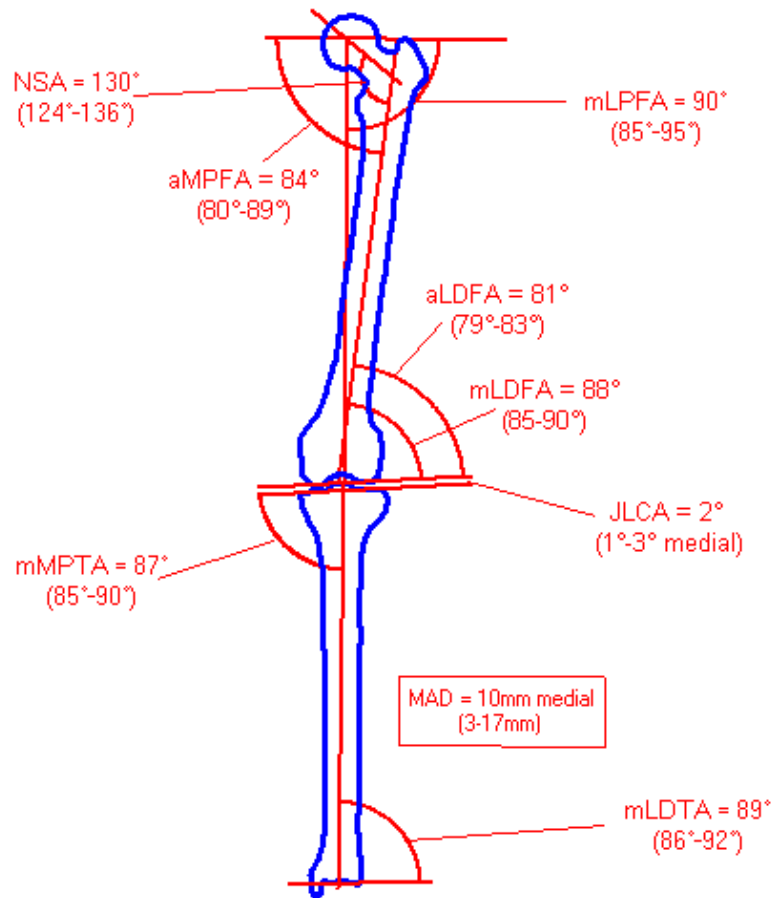
Requirements: All joint centers and both anatomical axes are shown.
Result: The preoperative mechanical axes and the center line are automatically inserted and are shown as a preview together with all relevant values.

Scheme and abbreviations:

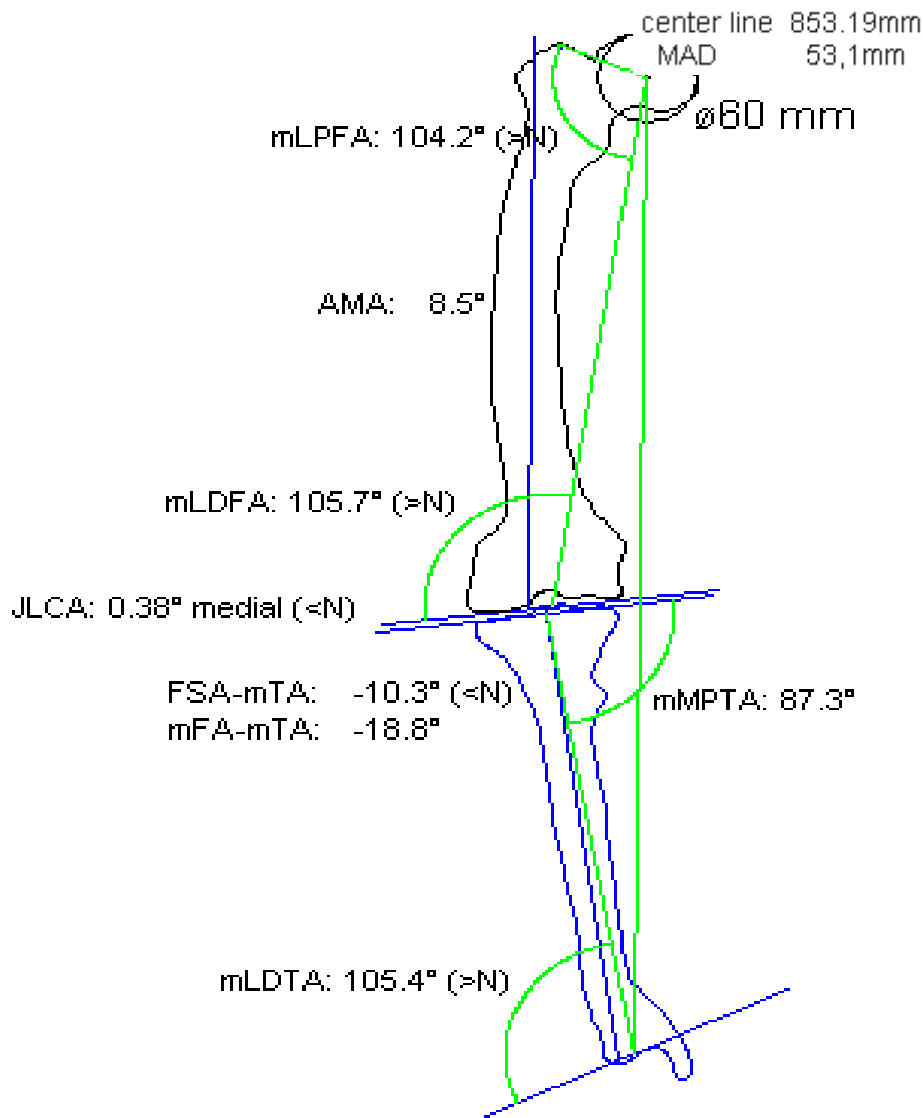
- | | |
|---------------|---------------|
| m= mechanical | a= anatomical |
| D= distal | P= proximal |
| F= femur | T= tibia |
| A= angle/axis | |

- | | |
|-------|----------------------------------------------------------------------------------------------------------|
| NSA | Neck Shaft Angle (= CCD-angle) |
| KJL-F | Knee Joint Line–Femur (proximal knee base) |
| KJL-T | Knee Joint Line–Tibia (distal kneebase) |
| JLCA | Joint Line Conversion Angle (angle between KJL-F and KJL-T) |
| AMA | Anatomical Mechanical Angle (angle between anatomical and mechanical axis) |
| ACA | Angle of Correction of Angulation (center of the maldisposition, valid for the module Osteotomy II only) |
| RDA | Real Deformity Angle (Real angle of the maldisposition, valid for the module Osteotomy II only) |

The nomenclature of all values as Dror Paley Standard Measurements
 Description of the normal values:



Actual preoperative dimensions:



When activated, the function **Preoperative dimensions** and the preview with all relevant dimensions are attached to the mouse pointer.

	L: Destination point	Measure femure AF
	R: Exit function	
	M: Free	

- L** ● To place the graphic to the requested position, use the left mouse button.
- R** To return to the **Osteotomy tool**, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The preoperative dimensions belong to your planning and are important for further judgments and documentation.

Note: Position the objects on the **left** next to the x-ray. This leaves enough space for the previews of the postoperative joint situation on the **right** side next to the x-ray.

Step 13 Osteotomy Basics **13**

Preoperative dimensions

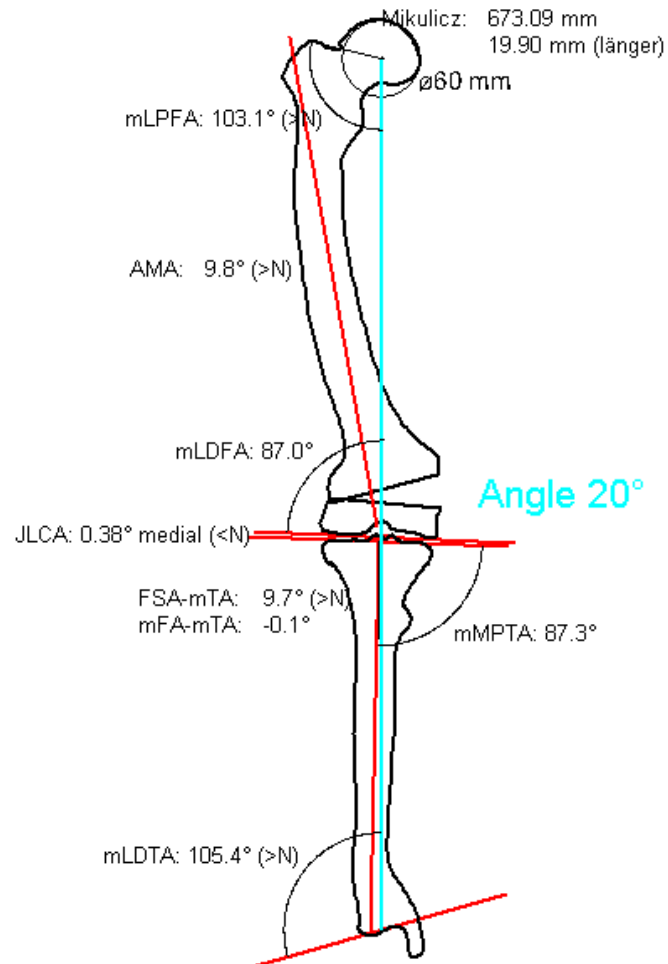
Osteotomy

Measure of the bone

- center line 853.19mm
- MAD 53,1mm
- 19,90mm longer

Requirements: All joint centers and both anatomically axes must be shown.

Result: The postoperative situation is simulated in a preview. The mechanical and anatomical axes are shown as well as the center line. The Orthopaedic Application calculates the resection angle automatically if possible. Otherwise an angle of 0 degree is shown.



Without (N) = normal
Value
(> N) = above Normwert
(< N) = below Normwert

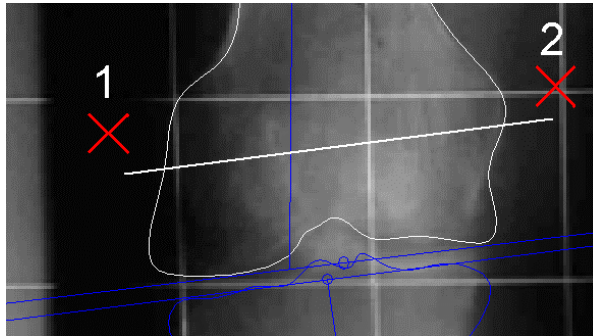
Step 13a Osteotomy single resection only **13a**




Note: First, draw the base line for the resection on the desired position. It is up to you where you place the basic line. The Orthopaedic Application calculates the postoperative result to achieve the optimal situation of axes.

You can accept the result or make your own manual calculation to determine the position of the center line yourself.

The Orthopaedic Application allows you to make as many previews as necessary or required.

You also can calculate two osteotomies instead of one. This is described with **Step 13b**. We start with the base line.



 L: 1. of 2 points of intersection line  R: Exit function  M: Free	Osteotomy tool Attention: Osteotomy on the original and NOT on a preview!
-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------

Attention: draw the resection lines always on the x-ray, NOT on a preview!

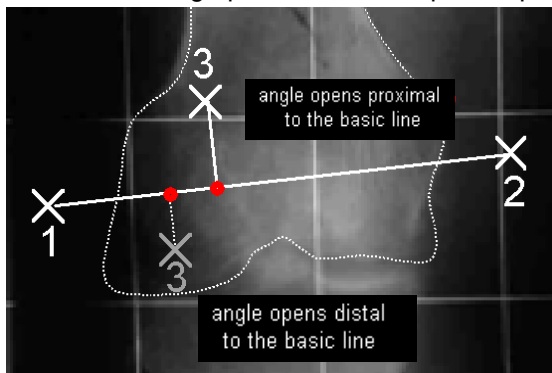
- L** ● To place the first point of the base line (1) , use the left mouse button.
- R** To go to the **Module tool**, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

 L: 2. of 2 points of intersection line  R: Back  M: Free	Osteotomy tool Attention: Osteotomy on the original and NOT on a preview!
--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------

- L** ● To place the second point of the base line (2) , use the left mouse button.
- R** To return to point 1, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

An auxiliary line is attached to the mouse pointer. Place the mouse pointer perpendicular to a position that defines the rotation center of the angle. For an open wedge (refer to picture below) place the mouse pointer as shown here with point 3 above the basic line.

For a closed wedge place the mouse pointer perpendicular below the basic line.



Note:

Point 3 above the basic line means:

the correction angle opens proximal to the basic line.

Point 3 below the basic line means:

the correction angle opens distal to the basic line. The rotation center of the angle is placed always perpendicular to the auxiliary line on the basic line.

Open Wedge/Closed Wedge

With the position medial or lateral to the anatomical femoral/tibial axis you define open or closed wedge.

The preview of the postoperative result is automatically attached to the mouse pointer.

	L: Rotation center	Osteotomy tool
	R: Back	Attention: Osteotomy on the original and NOT on a preview!
	M: Free	

- L ●** To define the rotation center of the angle (3) and open or closed wedge, use the left mouse button.
- R** To return to point 2, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

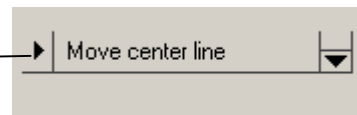
	L: Destination point	Osteotomy tool
	R: Exit function	
	M: Free	

- L ●** To place the preview on the desired position left side next the x ray, use the left mouse button.
- R** To return to the Osteotomy tool, use the right mouse button.
- M** Define the position of the point Free of your choice.

The preview is placed temporary.

You now have the following options:

- a) Finally accept it
- b) Manually correct it
- c) Delete it and start again with the basic line.



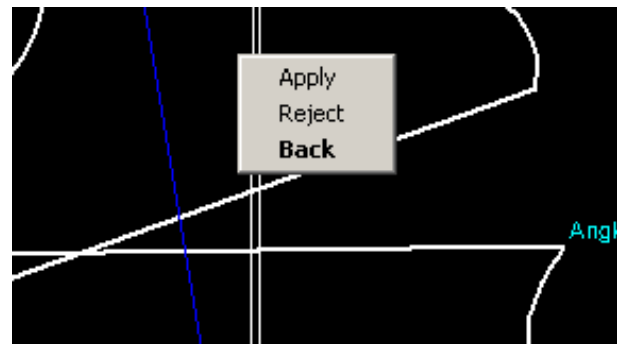
	L: Grab point	Osteotomy tool
	R: Accept/Reject planning	Press return to accept planning
	M: Free	

- L ●** To manually correct the angle by rotating the femur, use the left mouse button. Grab the femur at a position of your choice. and rotate it. All angles change and the values are shown.
- L ●** To confirm the changed result, use the left mouse button.

This procedure can be repeated many times: grab, rotate, and place.

- R ●** To open a window to select, use the right mouse button.

- L ●** Confirm with **apply** you confirm the preview, with **reject** you delete the preview and return to the **Osteotomy tool** with **back** you can manually change the result again.



An open wedge osteotomy is proceeded and shown.

Note

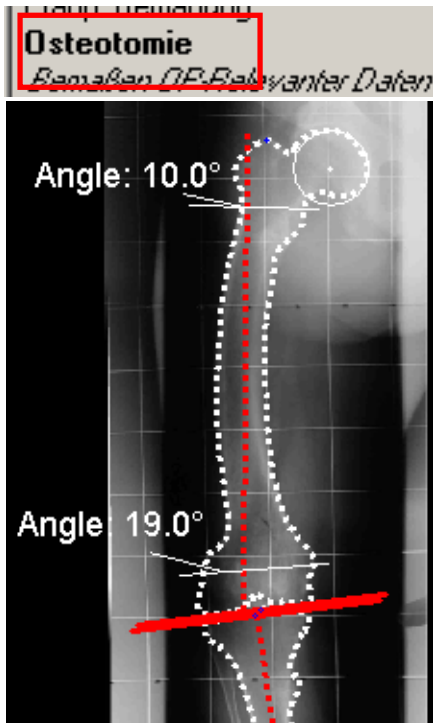
To calculate and show many previews it is not necessary to delete the previous previews.

Caution: To proceed a new intersection line at the same areas before the previous intersection has to be deleted on the **original image**. Afterwards, continue with **Step 13**.

This procedure can be repeated many times.

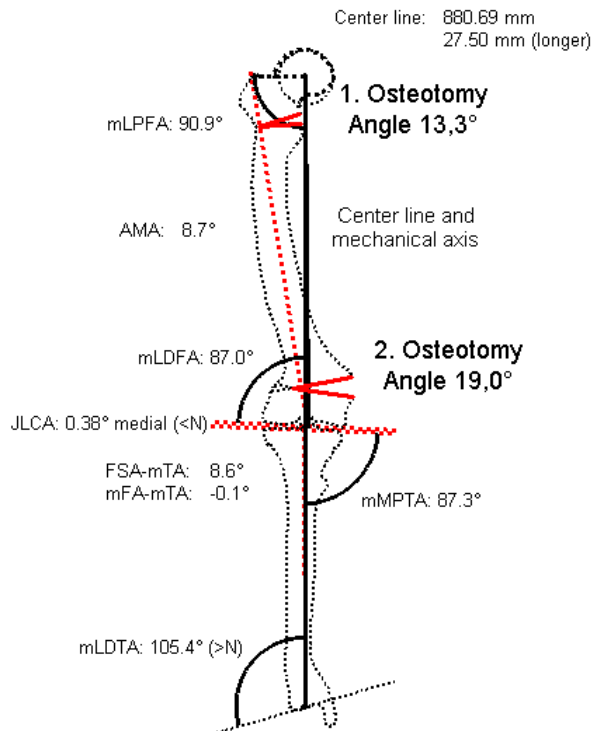
Step 13b Osteotomy double resections

13b



Requirements:

All joint centers and both anatomically axes must be shown. **Result:** The postoperative situation is simulated in a preview. The mechanical and anatomical axes are shown as well as the center line.



The Orthopaedic Application calculates the resection angle automatically if possible. Otherwise an angle of 0 degree is shown.

Caution:

For an optimal calculation of a double osteotomy you must start the first resection on the proximal femur.

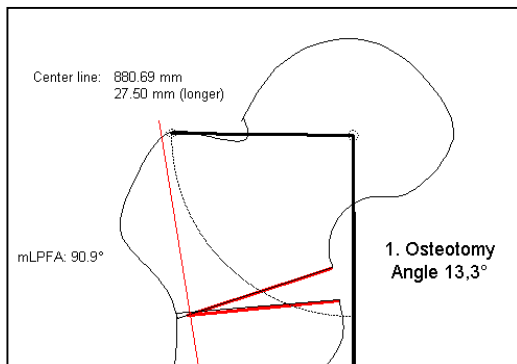
For a tibial double Osteotomy you start the first resection on the distal tibia.

The reason is the rotation center of the mechanical axes.

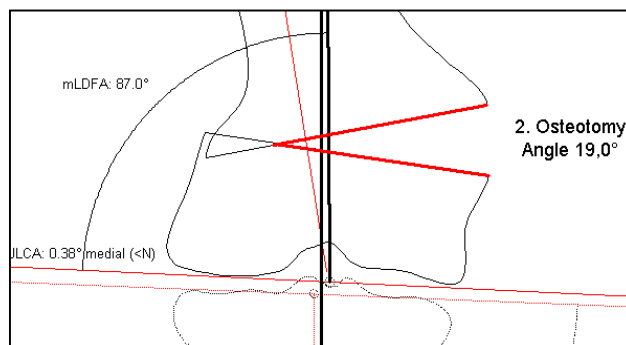
The longer the distance between the kneebase line and the resection line the shorter the rest of the axis and the bigger the angle. A large size of an angle may occur, for example, 85°.

NOTE: All resections are realized only on the x-ray.

If it was done by mistake on a preview the calculated angle will be 0° or another unlikely result.



Detail first resection



detail second resection

First, draw the base line for the resection on the desired position. It is up to you where you place the basic line. Afterwards the Orthopaedic Application calculates the postoperative result to achieve the optimal situation of axes. The angle for an optimal result is not possible in this case. This is the reason EndMap indicates an angle of 0°. You correct it manual with your required angle.





 L: 1. of 2 points of intersection line
 R: Exit function
 M: Free

Osteotomy tool

Attention: Osteotomy on the original and NOT on a preview!

- L** ● To place the first point of the base line (1) , use the left mouse button.
- R** To go to the **Module tool**, use the right mouse button.
- M** Define the position of the point **Free** of your choice.


 L: 2. of 2 points of intersection line
 R: Back
 M: Free

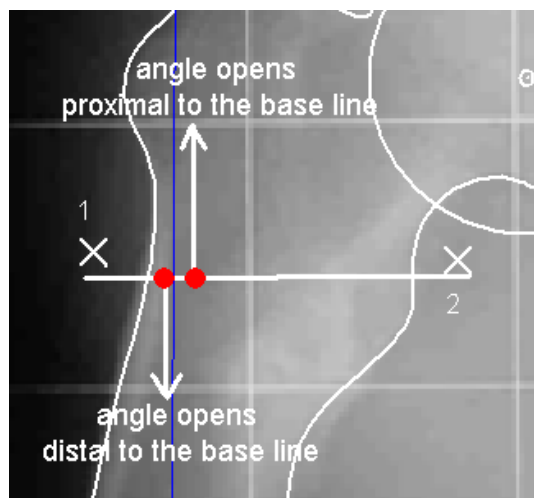
Osteotomy tool

Attention: Osteotomy on the original and NOT on a preview!

- L** ● To place the second point of the base line (2) , use the left mouse button.
- R** To return to point 1, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

An auxiliary line is attached to the mouse pointer. Place the mouse pointer perpendicular to a position that defines the rotation center of the angle. For an open wedge (refer to the picture below) place the mouse pointer as shown here with point 3 above the basic line.

For a closed wedge place the mouse pointer perpendicular below the basic line

**Note:**

Point 3 above the basic line means:
the correction angle opens proximal to the basic line.

Point 3 below the basic line means:
the correction angle opens distal to the basic line.

The rotation center of the angle is placed always perpendicular to the auxiliary line on the basic line.

Open Wedge/Closed Wedge

With the position medial or lateral to the anatomical femoral/tibial axis you define open or closed wedge.


 L: Rotation center
 R: Back
 M: Free

Osteotomy tool

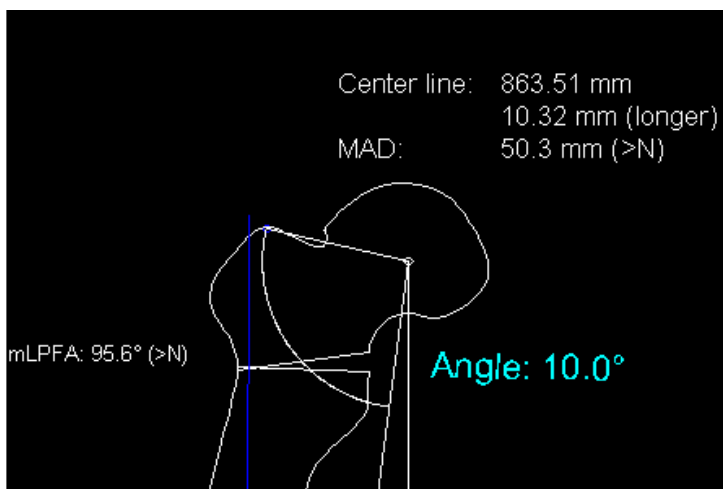
Attention: Osteotomy on the original and NOT on a preview!

- L** ● To define the rotation center of the angle (3) , use the left mouse button.
- R** To return to point 2, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

The preview is attached automatically to the mouse pointer. Place the preview on the desired position. The angle of correction is probably 0° in case no optimal calculation was possible.

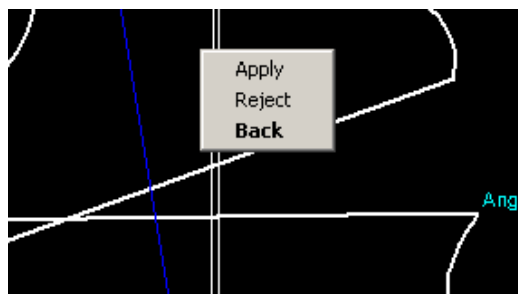


Grab the preview at any place around the hip head to turn the osteotomy up to a desired angle (here for example, 10°).



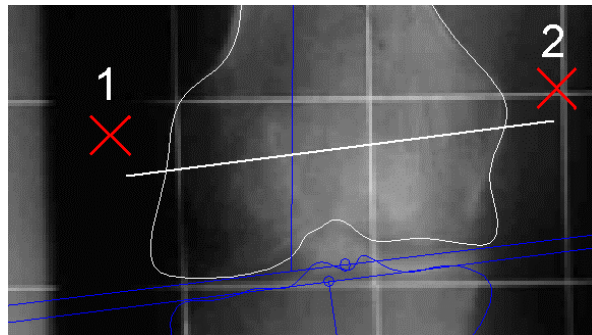
	L: Grab point	Osteotomy tool
	R: Accept/Reject planning	Press return to accept planning
	M: Free	




- L** ● To manually correct the angle of correction, use the left mouse button. Grab the femur at any place and turn the angle up to the desired size (here for example, 10°). All changing values are shown simultaneously.
- L** ● To confirm the result, use the left mouse button. This procedure can be repeated many times.
- R** ● To make the selection appear, use the left mouse button.
- L** ● To select **Apply**, use the left mouse button.



Caution: To proceed the second resection return to the **original image** and place the second basic resection line on the distal femur. You do the second resection the same way as the first resection.

NOTE: Depending on the preoperative situation and the first osteotomy (here on the proximal femur) always tries automatically to achieve the optimal position of the center line.






 L: 1. of 2 points of intersection line
 R: Exit function
 M: Free

Osteotomy tool

Attention: Osteotomy on the original and NOT on a preview

- L** ● To place the first point of the base line (1) , use the left mouse button.
- R** To go to the **Module tool**, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

 L: 2. of 2 points of intersection line
 R: Back
 M: Free

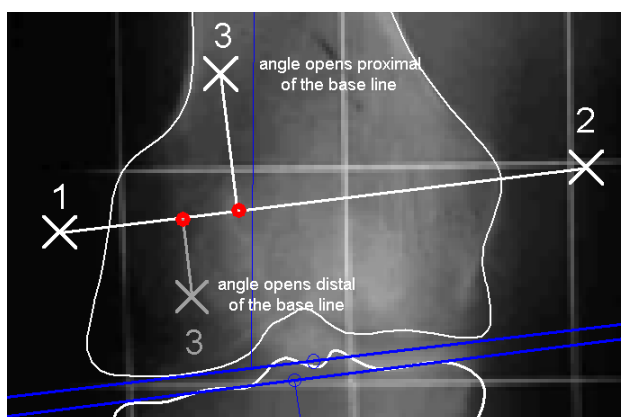
Osteotomy tool

Attention: Osteotomy on the original and NOT on a preview!

- L** ● To place the second point of the base line (2), use the left mouse button.
- R** To return to point 1, use the right mouse button.
- M** Define the position of the point **Free** of your choice.

An auxiliary line is attached to the mouse pointer. Place the mouse pointer perpendicular to a position that indicates the rotation center of the angle. For an open wedge (refer to the picture below) place the mouse pointer as shown here with point 3 above the basic line.

For a closed wedge place the mouse pointer perpendicular below the basic line



Note:

Point 3 above the basic line means:
the correction angle opens proximal to the basic line.

Point 3 below the basic line means:
the correction angle opens distal to the basic line.

The rotation center of the angle is placed always perpendicular to the auxiliary line on the basic line.




Open Wedge/Closed Wedge

With the position medial or lateral to the anatomical femoral/tibial axis you define open or closed wedge.

  	L: Rotation center R: Back M: Free	Osteotomy tool Attention: Osteotomy on the original and NOT on a preview!
-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	------------------------------------------	------------------------------------------------------------------------------

L ● To define the rotation center of the angle (3), use the left mouse button.

The second preview is attached to the mouse pointer. Place it on the desired position.
 The automatically displayed angle indicates the optimal result regarding best possible position of the mechanical axes and the center line.

  	L: Destination point R: Exit function M: Free	Osteotomy tool
-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-----------------------------------------------------	----------------

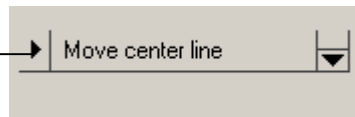
L ● To place the preview on the desired position left side next the x-ray, use the left mouse button.

R To return to the Osteotomy tool, use the right mouse button.

M Define the position of the point Free of your choice.

The preview is placed temporary.
 You now have the following options:

- a) Finally accept it
- b) Manually correct it
- c) Delete it and start again with the basic line.



If you do not accept the result, proceed as follows

  	L: Grab point R: Accept/Reject planning M: Free	Osteotomy tool Press return to accept planning
-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------	---------------------------------------------------

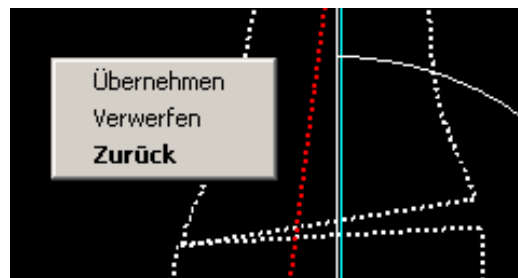
L ● To can manually change the angle, use the left mouse button. Grab the femur at any place and rotate it. All changing angles are shown.

L ● To confirm the result, use the left mouse button.

This procedure can be repeated many times

R ● with the right mouse button a window appears, use the right mouse button.

L ● with the left mouse button you select **Apply**.



The complete Osteotomy with multiple resections is displayed on the screen.

<p><i>Measure OF-relevant data</i></p> <div style="border: 2px solid red; padding: 2px;"> <p>Measure angles</p> <p>Measure distances</p> </div> <p>Plates/Angles/Nails</p>	<p style="text-align: center;">Step 14 Define measurements in mm</p> <p>For more information, refer to "Hip endoprosthesis STEP 13 and 13a".</p>	14
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Further reading

Module Coxometry

D.Tönnis: Die angeborene Hüftdysplasie und Hüftluxation im Kindes- und Erwachsenenalter
Springer Verlag, Berlin, Heidelberg NewYork 1984, Kapitel 9- Allgemeine Röntgendiagnostik des Hüftgelenkes, S.104-147
(Beschreibung, Normwerte, weitere Literaturangaben)

Johannes Hellinger. Meßmethoden in der Skelettradiologie, Thieme Verlag 1995, ISBN 3131197013
Aus diesem Werk stammt die Mehrzahl der in **mediCAD** angegebenen Normalwerte!!)

Hilgenreiner H.(1925) Zur Frühdiagnose der angeborenen Hüftgelenksverrenkung. Med.Klin. 21: 1385-1388

Kleinberg S und Liebermann H (1936) Acetabular index in infants in relation to congenital dislocation of the hip. Arch.Surg. 32: 1049-1054

Laurenson R (1959) The acetabular index. J Bone Jt Surg (Br) 41:702

Normalwerte aus

Hellinger 1995 (s.o.)

Tönnis und Brunken 1968. Eine Abgrenzung normaler und pathologischer Hüftpfannendachwinkel zur Diagnose der Hüftdysplasie. Arch Orthop trauma Surg 64:197-228

Wilcinson J, Carter C.(1960) Congenital dislocation of the hip. The results of conservative treatment. J Bone Jt Surg[Br] 42:669-688

Zippel 1971 Normal development of the structural elements of the hip joint in adolescence]
[Untersuchungen zur Normalentwicklung der Formelemente am Hüftgelenk im Washstumsalter.]Beitr Orthop Traumatol 1971 May;18(5): p255-70

Masafumi Hamma M.D., Glenn E. Lipton, J.Richard Bowen M.D. Alfred I. du Pont Institute, 1600 Rockland Road
Wilmington, De 19803: The remodelling of femoral head deformity after primary Healing in legg-calve-Perthes Disease.

Aktuelle Literatur (Beispiel)

Gotoh E; Tsuji M; Matsuno T; Ando M .Acetabular development after reduction in developmental dislocation of the hip. Clin Orthop (United States), Sep 2000, (378) p174-82

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Abbreviations

a	anatomical
A	Angle/ Axis
ACA	Angle of Correction of Angulation (only for module Osteotomy II, here not relevant) (see Module Knee Endoprostheses)
ACE	angle according to Wiberg or CE angle = anterior center-edge angle (see Module Coxometry)
ACE	angle according to Wiberg/CE-angle (see Module Coxometry)
ACE-angle	(see Module Coxometry)
AC-Hilg	acetabular angle according to Hilgenreiner (if the Y-cartilage is open) (see Module Coxometry)
ACM	angle according to Idelberger and Frank (see Module Coxometry) CCD angle
MZ	decentralized distance line used to calculate the hip index (see Module Coxometry)
ACM-angle	(see Module Coxometry)
AC-SZW	acetabular angle (angle of sclerotic area of the roof of the acetabulum if the Y-cartilage is closed) (see Module Coxometry)
ACW	Acetabular angle (see Module Coxometry)
ACW-HL	Acetabular angle according to Hilgenreiner if the Y-cartilage is open (see Module Coxometry)
ACW-SZ	Acetabular angle = angle of sclerotic area of the roof of the acetabulum if the Y-cartilage is closed (see Module Coxometry)
aL DFA	anatomical Lateral Distal Femoral Axis (see Module Knee Endoprostheses)
AMA	Anatomical Mechanical Angle (angle between anatomical and mechanical axis) (see Module Knee Endoprostheses)
aMLFA	anatomical Medial Lateral Femur Axis (see Module Knee Endoprostheses)
aMPFA	anatomical Medial Proximal Femur Axis (see Module Knee Endoprostheses)
BETADIFF	Deviation of calculated direction of pull of the abductor muscles from their ideal direction of action (see Module Biometry)
CCD	Centrum Collum Diaphysen angle (see Module Coxometry)
CE-angle	(see Module Coxometry)
Center Line	Mikulicz (see Module Knee Endoprostheses)
D	distal (see Module Knee Endoprostheses)
FNA	Femoral neck axis (see Module Coxometry)
FSA	Femurshaftaxis
FSA-mTA	Femur Shaft Axis (anatomical) – mechanical Tibia Axis (see Module Knee Endoprostheses)
HJC	Hip Joint Center
HL	Hilgenreiner line (e.g. Ischioal Bone Line) (see Module Coxometry)
HPKI	acetabulum-femoral head index according to Heymann and Herndorn (see Module Coxometry)
HPKI	Hüft Pfannen Kopf Index (Englisch: acetabulum femoral Head Index) (see Module Coxometry)
HW	Hip index according to Busse, Gasteiger and Tönnis (see Module Coxometry)
HW	Hüft Wert (englisch Hip Index) nach Busse, Gasteiger und Tönnis (see Module Coxometry)
JLCA	Joint Line Conversion Angle (angle between KJL-F and KJL-T) (see Module Knee Endoprostheses)
KJL-F	Knee Joint Line – Femur (proximal knee base) (see Module Knee Endoprostheses)
KJL-T	Knee Joint Line – Tibia (distal knee base) (see Module Knee Endoprostheses)
KLDELTAOPT	Direction of pull of the rectus femoris muscle in relation to the horizontal in an ideal joint situation (see Module Biometry)
L	Large
L	Lateral (see Module Knee Endoprostheses)
m	mechanical (see Module Knee Endoprostheses)
M	Medium
MAD	Mechanical Axis Deviation (see Module Knee Endoprostheses)
mFA-mTA	mechanical Femur Axis – mechanical Tibia Axis (see Module Knee Endoprostheses)

Mikulicz	center line (see Module Knee Endoprostheses)
mLDFA	mechanical Lateral Distal Femoral Axis (see Module Knee Endoprostheses)
mLDTA	mechanical Lateral Distal Tibia Axis (see Module Knee Endoprostheses)
mLPFA	mechanical Lateral Proximal Femoral Axis (see Module Knee Endoprostheses)
mMPTA	mechanical Medial Proximal Tibial Axis (see Module Knee Endoprostheses)
MZ	decentralized distance line used to calculate the hip index (see Module Coxometry)
NSA	Neck Shaft Angle /CCD angle (see Module Knee Endoprostheses)
NSA	Neck shaft Axis (see Module Coxometry)
P	Proximal
PNW	Acetabular inclination angle according to Ullmann(see Module Coxometry)
PFNW	Pfannenneigungswinkel (engl. acetabular inclination angle (see Module Coxometry)
PNW/US	acetabular inclination angle according to Ullmann (see Module Coxometry)
RDA	Real Deformity Angle (only for module Osteotomy II, here not relevant) (see Module "Osteotomy II)
RREL	Resulting joint counterforce relative to body weight (see Module Biometry)
S	Small
SZWITH	Theoretical direction of the resulting joint counterforce in relation to the horizontal (position of the sclerotic area) (see Module Biometry)
TL	Traglinie (Center line) (see Module Knee Endoprostheses)
TSA	Tibia Shaft Axis (see Module Coxometry)
US	Ulmann Sharp (see Module Coxometry)
VD5ABD	Ratio of lever lengths (vertical distance of directions of pull from the rotation center) of the center of gravity of part of the body and the abductor muscles (see Module Biometry)
VRECABD	Ratio of lever lengths (vertical distance of directions of pull from the rotation center) of the rectus femoris and the abductor muscles (see Module Biometry)

IMPAX Orthopaedic
Application User's Guide
Osteotomy Manual



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1/26/2005

Revision Record

Document Name: IMPAX Orthopaedic Application User's Guide, Osteotomy Manual

Revision date	Description
January 2004	Initial version
January 2005	Updated Copyright information

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Welcome

The *Orthopaedic Application* provides you with a high-performance tool for the precise planning of hip implants. The *Orthopaedic Application* enables you to work without film at traumatological, orthopaedic and paediatric workstations.

Modules

The *Orthopaedic Application* supports you with the following modules:

- Hip Endoprosthetics for the systematic selection of prostheses and for planning hip implants to ensure an exact fit
- Hip Biomechanics (Biometry) for biometrically perfect preparation of implantation
- Coxometry for precise measurement of clinically relevant hip data for children's and adult's hips
- Knee Endoprosthetics for optimum planning of operations with the aid of both partial images and images of the whole leg in a standing position
- Osteotomy I for optimum planning of preoperative axis situation and simulation for single and multiple osteotomies.
- **Optional (described with this manual):**
Osteotomy II for calculation and correction of complex deformities of the lower limb as Dror Paley. This module will be delivered with a separate user manual.

Advantages

The *Orthopaedic Application* offers the following advantages over other methods of planning prostheses:

- Digital planning images and scan data are transferred from and sent back to the DICOM image archive, optimizing your workflow.
- Preoperative biometric measurements can be taken with the greatest precision with just a few clicks of the mouse.
A high standard of quality is ensured in preoperative diagnostics and treatment planning.
- All of the manufacturers templates that you need can be chosen selectively from a prostheses database. Prostheses can be adapted to the anatomical situation with the greatest precision. This helps to avoid in advance the danger of malpositioning, which can lead to premature loosening of the prosthesis.
- The *Orthopaedic Application* handling is far better because the user guides it.
- The time involved getting perfect planning is very little. Several functions have been optimized. Many single steps are now integrated into only one step.
- To work with the *Orthopaedic Application* is very similar to usual MS/Windows programs.
- The user interface can be translated into nearly all languages.
- *Orthopaedic Application* can be used within the daily clinical workflow as well as for scientific studies.

You will see just how quickly you can carry out the best possible planning with *Orthopaedic Application*.

Documentation

You can save the planning data as digital DICOM images in the database on your workstation and transfer these to a central DICOM archive. As a result you are able to retrieve the planning data quickly whenever necessary, for example for a follow-up or for a demonstration in a patient consultation.

It goes without saying that you can also print out the plans on a printer.

All relevant legal requirements are met when you use *Orthopaedic Application* (in Germany: SGBV5§136/137 ff.).

System description

The *Orthopaedic Application* planning software can be installed on your PACS System. The hardware requirements for these systems must be taken into account.

Intended use

The *Orthopaedic Application* is a program designed to help in the planning of surgical procedures in the field of orthopaedics and allows proper assessments to be made of geometrical changes in the lower extremities and therapeutic conclusions to be drawn. After the entry of correct patient data, the *Orthopaedic Application* provides the physician with additional information to be used in diagnosis which was previously unavailable from the X-ray images, or only very imprecisely.

The *Orthopaedic Application* enables the user to relate various procedures commonly used in medicine to precise measurements, thereby minimizing previous risks in diagnostics or ruling them out altogether.

The *Orthopaedic Application* allows precise digital planning and documentation of prosthesis implants and osteotomies on knee and hip joints.

Installing the *Orthopaedic Application*

Information about the installation of *Orthopaedic Application* are described on the Installation CD

Legal information

The operating and application software used in this product is protected by copyright. The software may only be used if it has been released by Hectec GmbH. Hectec GmbH reserves the right to make changes to the design, and therefore the technical data, without prior notice.

Data protection

Data relating to individual persons is subject to data protection. Ensure compliance with all applicable laws and regulations in your country.

Documentation

Orthopaedic Application

The *Orthopaedic Application* User's Guide contains detailed information on how *Orthopaedic Application* works and what functions it offers. You will find out how to operate the *Orthopaedic Application* and how to use it effectively. It also gives you many practical notes. A large number of illustrations help to clarify the working procedures.

Conventions

- L:** ● Click the left mouse button in order to do the indicated step
- R:** ● Click the right button in order to do the indicated step
- M:** ● Drawing mode, is preset, but can be changed if necessary

Warnings and safety information

To be able to use the *Orthopaedic Application* safely it is essential to read the User's Guide carefully. We assume that the *Orthopaedic Application* will only be used by expert personnel.

Warnings and notes are specially highlighted in the documentation.

NOTE:

This points out information on how to make best use of the equipment and the software and other useful information.

CAUTION: This highlights circumstances or consequences to which you should pay particular attention when working with the *Orthopaedic Application*.

WARNING:

This draws your attention to a situation or circumstances that can have serious consequences for the patient.

Basics

The *Orthopaedic Application* User's Guide, which you are currently reading contains detailed information on how the *Orthopaedic Application* works and what functions it offers. You will find out how to operate the *Orthopaedic Application* and how to use it effectively. It also gives you many practical Notes. A large number of illustrations help to clarify the working procedures.

Import of images

Original images

In order to plan prostheses with the *Orthopaedic Application* you can use digital images of different origins and from various sources. Suitable images for planning with the *Orthopaedic Application* are:

- DLR images (digital luminescence radiographie)
- SSD images (solid-state detectors)
- fluoroscopic images

DICOM images can be loaded from:

- databases
- other computers
- archives
- CDs

You can import images in various formats into your PACS System database:

- JPEG
- BMP
- TIFF

In addition you can scan in (digitize) film sheets by connecting your system to a scanner.

Image requirements

To obtain the best results in the *Orthopaedic Application* when planning prostheses you should only use images that satisfy the following requirements:

- The images must have been produced in accordance with Orthopaedic criteria.
- **WARNING:**
An indication of the scaling must be shown on the images (scaling sphere or scale bar).
- The images themselves must be taken in a way that enables the viewer to distinguish contrast and details.
- You should also optimize the windowing, for example—**before** loading the images in the *Orthopaedic Application*.

NOTE:

On the PACS System workstation, you should aim for a lighter image appearance to better emphasize the outlines.

NOTE:

The *Orthopaedic Application* can be integrated into nearly all PACS System workstations as an add-on module. The procedures for loading and importing pictures differ according to which workstation you are using.

Requirements for Osteotomy II as Dror Paley

Either images showing part of the leg or x-rays in a standing position showing the whole leg in an A-P (anterior-posterior) ray path are suitable for prosthesis planning with the Knee Endoprosthesis module.

A number of images showing part of the leg can be combined to produce an image showing the whole leg in the standing position.


Note:

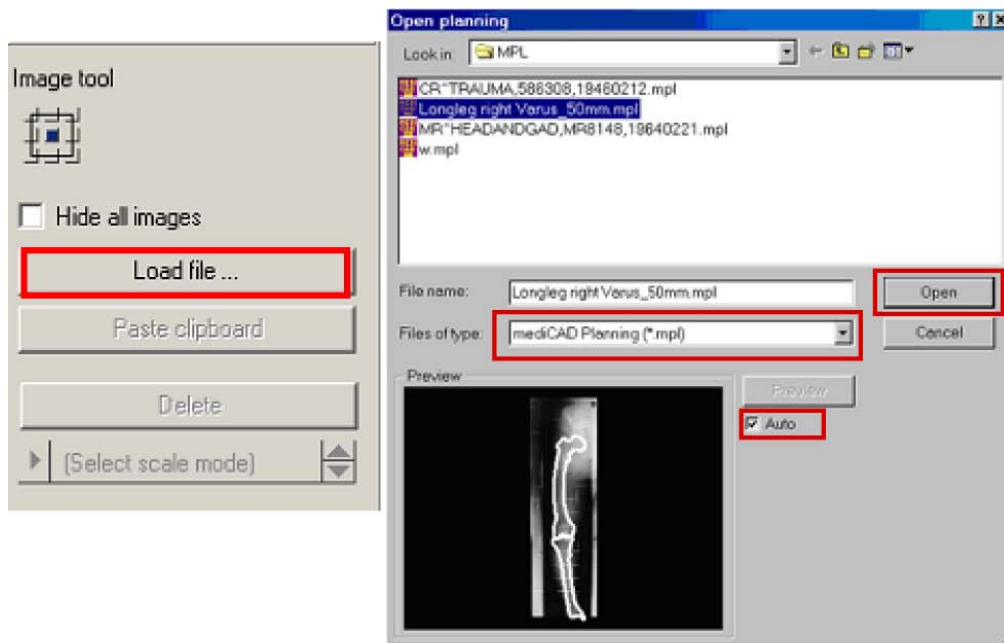
Axial misalignment can only be calculated correctly if the image used for planning fulfils the following requirements:

- A-P image showing one leg only (taken of both legs) or showing both legs in a standing position with equal weight on the legs
- Hip joint and ankle joint visible in full
- For calibration purposes, a lead scale (at the level of the longitudinal axis of the femur) must be shown on the image. For the sagittal view as well at the level of the longitudinal axis of the tibia.
- In order to use the module Osteotomy II as Dror Paley special knowledge of the principals are necessary. The training of the software requires this knowledge. (For literature see **Further readings** at the end of this manual).

Importing a DICOM image

In order to import DICOM images into the Orthopaedic Application:

- Start the Orthopaedic Application.
- On the vertical toolbar, click on the icon **Insert images**. 
- The **Image Tool** appears, click on **Load File**
- Select the drive and the directory where the image is stored.
- Select the Dataformat **DICOM Images (*.dcm.)** and click on the required file name in the File column.




- Activate **Auto** under Preview.
- Click on **Open**.
- The selected image is automatically displayed and you are prompted to scale the image.

Further information on this can be found under **Scaling images**

Importing other image formats from a file

To import non-DICOM images into the Orthopaedic Application, proceed in the same way as described under **Importing a DICOM image**.

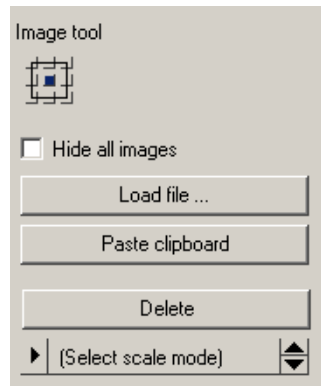
- Start the Orthopaedic Application.
- On the vertical toolbar, click on the icon **Insert images**. 
- The **Image Tool** appears, click on **Load File**.
- Select the drive and the directory where the image is stored.
- Select the Dataformat of the image you want to load and click on the required file name in the File column.
- Activate **Auto** under Preview.
- Click on **Open**.
- The selected image is automatically displayed and you are prompted to scale the image.

Further information on this can be found under **Scaling images**.

Importing images from the Clipboard

To import images that have been copied to the Windows Clipboard, proceed as follows:

- Copy the required images to the Clipboard.
- Open the **Orthopaedic Application**.
- Click on the **Insert image** icon.
- The **Image tool** appears,
- Select **Paste clipboard**.



- The selected image is displayed automatically and you are prompted to scale the image.

Further information you find under **Scaling images**.

Scaling images

The images must be scaled so as to enable measurements to be taken true to scale and to ensure that the prostheses will be inserted using the correct scale.

Warning:

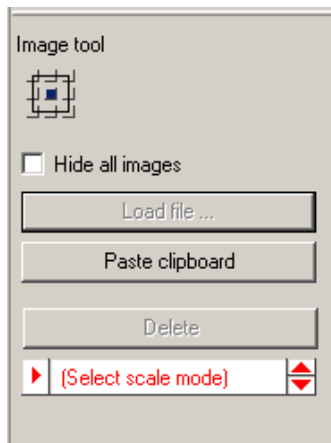
You can only scale the images correctly if a scale bar or a scaling sphere was placed in the image area when the image was taken.

The *Orthopaedic Application* offers you two methods of scaling:

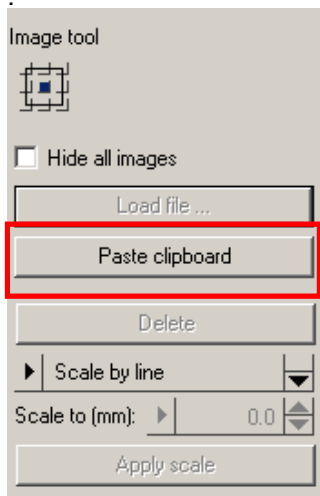
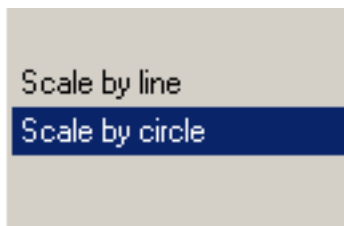
- Scaling with the aid of a circle, for example when a scaling sphere is visible in the image.
- Scaling with the aid of a distance line, for example when a scale bar is visible in the image.

Selecting the method

When you import a new image into the *Orthopaedic Application*, you are automatically prompted to scale the image. To achieve greater accuracy, enlarge the part of the image that contains the reference dimension by clicking on Zoom in or with the scroll wheel of the mouse:



Activate the method that you want to use by clicking on the appropriate button: **Line** or **Circle**.



Scaling with a line

To scale an image with the aid of a line:
Click on the start and end points of the distance line that you want to use, for example along the visible scale bar.

Enter the Length in mm and confirm this by clicking on *Apply scale* or *Return*.

Scaling with a circle

To scale an image with the aid of a circle:

Select two points on the outer edge of the scaling sphere by clicking on them with the mouse.
Drag the circle open with the mouse so that it matches the outline of the scaling sphere.

Fix the circle with another mouse click.

Enter the Length in mm and confirm this by clicking on *Apply scale* or *Return*

Warning: The steel ball supplied with the *Orthopaedic Application* has a diameter of 30 mm.

Correct scaling



If you want to correct the scaling later, proceed as follows:

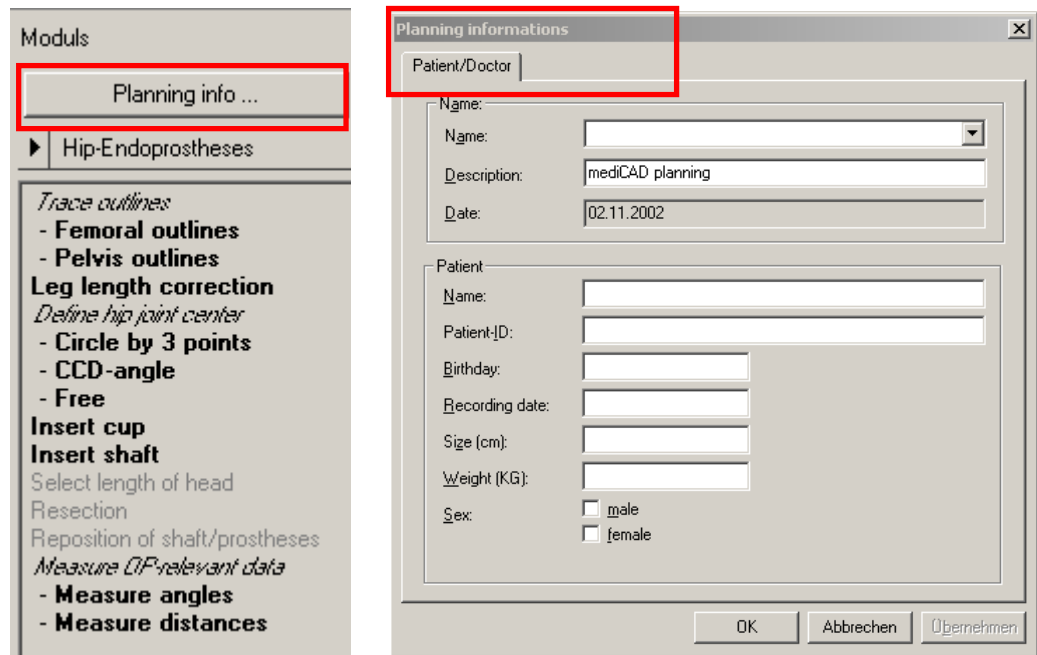
- Activate the function **Images** of the horizontal tool bar.
- The **Image tool** is shown. Click at any point on the inserted image.
- The function **Select scale mode** is activated.
- Go on as described above.

Complete planning data

CAUTION: This is mandatory for legal reasons.

In order to calculate geometrical parameters and for documentation purposes, information is required about the patient and the physician carrying out the planning. When a new image is loaded, a mask is generated automatically and if available the information about the patient will be taken from the image's DICOM header. You will have to add some information yourself.

This mask appears automatically whenever you want to save the *Orthopaedic Application* planning.



Warning: Choose a name that ensures an unambiguous connection between the planning data and the patient, for example: *patient name and date of birth*. Incorrect assignment between the drawing and the patient can have serious consequences.

If you save the planning, you are automatically required to prove and complete the **Planning Information**.

Check the planning information and make any necessary additions like your **name**.

Details of the height and weight of the patient are essential for **hip biometry**. For **hip endoprosthesis** you have to specify the side on which the prosthesis is to be inserted: left or right.

CAUTION: The data entered in this window from the DICOM header should only be changed in exceptional cases, for example if you want to save the planning image in a knowledge database.

If you do change the data, when it is returned to the local database on your PACS System a new series is created.

Correct planning information

If you want to correct any data later:

Click on **Planning Information** of the **Modules tool**.

The dialog window **Planning Information** is shown.

Correct or complete the data as described above.

After prostheses templates are inserted, a mask **Implants** is generated in which all prostheses data are taken over. Only the final templates are documented.

This implant information includes as well other data like ordering numbers or additional technical information about the inserted prostheses.

Printing and saving

You can print and save the results of your planning at any time when you are using the *Orthopaedic Application*.

Printing

You specify the printer that you want to use and the paper format in the print setup.

Before starting printing you can choose from a number of other, *Orthopaedic Application*-specific, options for processing the print job.

Saving

To continue your work at a later date or if necessary make corrections, save the planning drawing as an mpl file in the file system on your PC.

When planning is completed, transfer the planning image to the database on your PACS System workstation.

NOTE: When the data is transferred to the database on your PACS System workstation, the graphical objects such as outlines, prosthesis templates and text are permanently integrated in the images and can no longer be changed.

Printer settings

The printers available for printing are those that are installed at your workstation.



Activate with the Icon **Print** of the Horizontal Toolbar the **Print area tool**. Choose the **Print setup** and select your settings.

For further print options, refer to the **Horizontal Toolbar**. See **Print**.

Saving

Saving as mpl and as DICOM

There is a basic difference between images in the *Orthopaedic Application* format mpl and a final DICOM image.

mpl

To continue work on or correct the planning drawing at a later date, you need to save the drawing as an mpl file.

Note: The planning data is stored on the hard disk of your PC. It is not stored in the database of PACS System application, however.

DICOM

Final plannings should be transferred to the local database on your PACS System

Note: When a drawing is transferred to the local database, the outlines, templates, and text that you have entered are permanently integrated into the image and can no longer be changed at a later date.

Both methods to save are described in **Horizontal Toolbar**, see **Save**

Transfer drawing into the database of a PACS System

After completing planning, you can transfer the planning image to the local database on your PACS or RIS System.

To do this, save the image in DICOM format in an export directory, where it is retrieved automatically and saved in the database.

You can then make use of the advantages of DICOM communication and send the planning image in digital form to wherever it is required, for example the operating theatre. You can also transfer the image to a DICOM long-term archive.

NOTE:

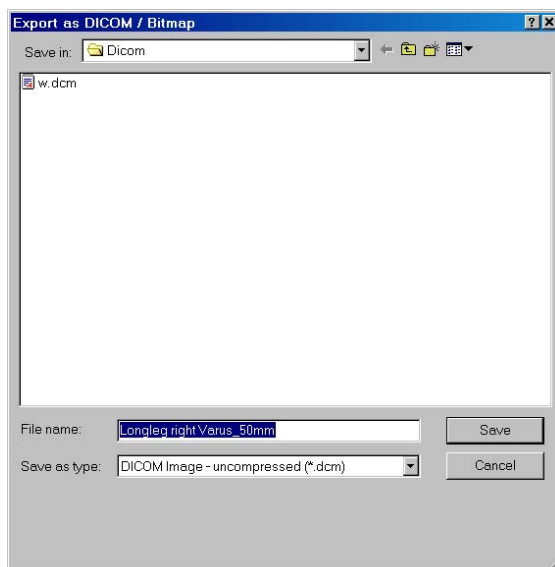
When a drawing is transferred to the local database, the outlines, templates and texts that you have entered are permanently integrated into the image and can no longer be changed at a later date.

Transfer drawing into the database

Choose in the Menu bar **File** and the function **Export as DICOM/Image**.

The **Export as Image** dialog window is displayed.

The export directory is already selected when preset. If not, select it.



- Check the **Planning Information** and confirm with OK.
- Type in the file name that you want to use. You should only accept the default file name "New Image" if you want to overwrite the existing drawing.
- Drawings contained in this directory have normally not yet been saved in your local database.
- Do not change the file type **DICOM uncompressed**.
- Click on the **Save** button.
- A confirmation query alerts you if a file of this name already exists.
- Respond to this confirmation query with **No** if you do not want to overwrite the existing drawing, or click on **Yes** if you do want to overwrite the drawing.
- The drawing is saved as a DICOM image.
- Select File **Exit** from the menu to exit the *Orthopaedic Application*.
- You are asked if you want to save the drawing as an .mpl file.
- **NOTE:** drawings that have been saved as .mpl files will still be available later for modification in the *Orthopaedic Application*.
- Confirm the message as required by clicking on **Yes** or **No**.
- The *Orthopaedic Application* is closed.

Saving onto your PACS System

Together with the DICOM image all information about the patient, the inserted prostheses and all drawings are saved.

On your PACS System, the planning image is automatically transferred to the local database as a new series for the patient in question, and is subsequently deleted from the export directory.

The contents of the database are managed in the Patient List.

Delete drawing

Drawings that you no longer need can be deleted from your hard disk by using the MS/Windows-Explorer.

Deleted is the .mpl file, not the DICOM image that you may have transferred to the local database in the meantime.

Working with the *Orthopaedic Application* Screen layout

The *Orthopaedic Application* screen is divided into the following areas:

Title bar and menu bar

The title bar shows the name of the program. If you have already saved your planning drawing at least once before, the name of this is also displayed. From the menu bar you can activate various general functions, for example the *Orthopaedic Application* settings.

Note: the *Orthopaedic Application* is delivered with effective presets. If you lost the presets, a new installation of the Installation CD is recommended.

Horizontal and vertical toolbars

The Horizontal Toolbar contains the icons for find the general functions that are available to you in all modules.

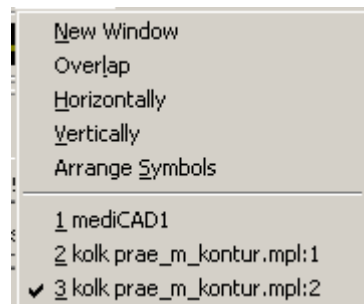
Module and Function Bar

This guides users through the work routines step by step. The function tools are automatically opened when activating a function.

- Still open steps are **dimmed**
- Finished steps are not dimmed
- Step with several options are *in italics*
- Steps, which you can not activate are in light grey

Display area

The loaded image is displayed in the display area, where you also edit it. You may divide the display area in several windows. In one of them you edit with a zoom while you see the image overview with the other window. Changes are automatic transferred.

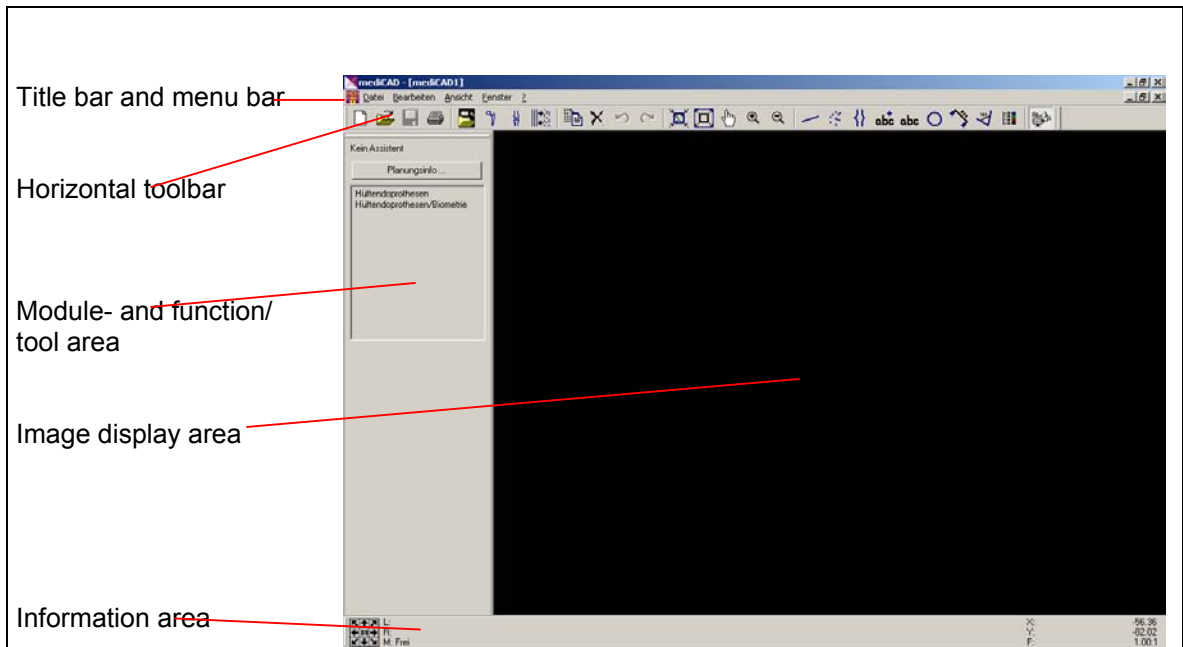


For Settings look to the Menu Bar under **Window**
The active window has a blue title bar.

Information area

The information area provides information that makes it very easy for you to work with the *Orthopaedic Application*. For example:

- in this area the function tool guides you step by step through all the procedures
- the coordinates of the mouse pointer are shown
- you will find the buttons for moving the displayed image segment



The tool area

The tool guides you step by step through all the functions: The step that you have to perform next in order to successfully complete the procedure is shown in the **Information area** (lower screen area).



- L:** next action with left mouse button
- R:** next action with right mouse button
where to use the right mouse button:
back means 1 or more steps back
cancel means finish the actual function
finish selection means finish selecting elements
- M** **Drawing mode**, each function has a reselected mode








To change the mode, use the keyboard. Except the mode **Free** all modes are snap to modes.

Note: Take care that the *shift* key is not activated for setting the mode you want to work with

- Key **E** **End points**—position points on end points, for example end of lines, E is a snap to element mode or end of an element
- Key **F** **Free mode**—position points anywhere you choose
- Key **L** **Line/Element**—position points on lines of elements, for example on a pelvis line or femur outline, L is a snap to line mode
- Key **M** **Midpoint**—position points on midpoints of lines etc., **M** is a snap to mid mode
- Key **P** **Point**—you can only position points on defined points, like center point of a circle or a cup or a neck of prostheses, P is a snap to mode
- Key **S** **Intersection**—you can only position points on intersections

More short keys

Note: for setting the mode you want to work with take care that the *shift key* is not activated

Key h	Half size of the image, no icon available for this function	
Key a	Full size of the image, same function as this icon	
Key w	To enlarge a certain section of an image you define a window with the mouse same function as this icon	
Key c	Deletes elements, same function as this icon	
Key u	Deletes the latter step you have done, same function as this icon	
Key shift u	One step forward, same function as this icon	
↑	1 smaller size of a prostheses	
↓	1 larger size of a prostheses	
-	Zoom smaller	
+	Zoom large	
→	rotates objects anti clock wise	
←	rotates objects clockwise	

Planning overview

In order to plan and document the surgical procedure with the *Orthopaedic Application* you follow the general procedure described below:

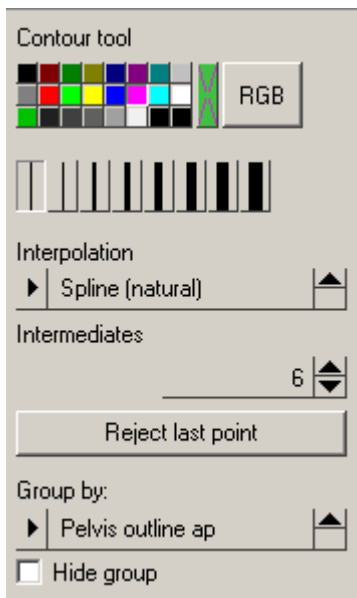
1. First load the image that you want to use for prosthesis planning into the *Orthopaedic Application*. Alternatively you can load a planning image saved previously in order to edit it further. Then you have to scale the image. This is essential for the *Orthopaedic Application* to be able to insert the selected prosthesis true to scale and to determine the correct dimensions.
2. Check and complete the **Planning Information**.
3. Then you select the required processing module and perform the necessary editing steps. The steps are listed in the **Modules** assistant and are listed according to your used work routine.
 - still open steps are **dimmed**
 - finished steps are not dimmed
 - step with several options are *in italics*
 - steps, which you can not activate are in light grey

Modules are

- **Hip Endoprosthesis** for targeted prosthesis selection
- **Hip Biomechanics /Biometry** to ensure that implantation is perfectly prepared with respect to biometric criteria
- **Knee Endoprosthesis** for optimum planning of knee prostheses
- **Coxometry** for precise measurement of clinically relevant hip parameters
- **Osteotomy I** for optimum planning of axis correction
- **Osteotomy II** for calculation and correction of complex deformities of the lower limb as Dror Paley. This module is delivered with a separate manual and needs additional training.

When you choose a function or a step the **Tool Assistant** according to the function opens and shows all options you may have with that specific function. For example:

You draw outlines of femur or tibia—the **Contour Tool** opens



You can choose colors and size for your line, the kind of line like spline or Polyline, the number of intermediate points (preset with 6 points), and the group to which the line should belong to like femur-outline or pelvis-outline.

Later on you can fade out or fade in if you temporarily don't need the line or contour.

For nearly each function the **Orthopaedic Application** offers you the special tool for your convenient use.

You may skip steps that you do not want to follow. You may follow steps in another sequence than listed.

You cannot follow steps, which are light grey and not activated. Those steps need a function selected. After you have deleted a step/Function it will be listed **dimmed** again.

You may also use functions in your **Horizontal Toolbar** without using the **Module tools**

4. Define dimensions relevant during the operation.
 5. Finally print or/and save as mpl or DICOM.
- When planning is completed you can transfer the planning image to the database on your workstation.

Often used functions

Delete elements

Procedure:

Click on **Delete**



	L: Delete element or define first corner of area	Contours
	R: Back	
	M: Element or Line	

- L** ● With the left mouse button, select the element you want to move.
or
- L** ● Use the mouse to drag open an area covering the required image section.

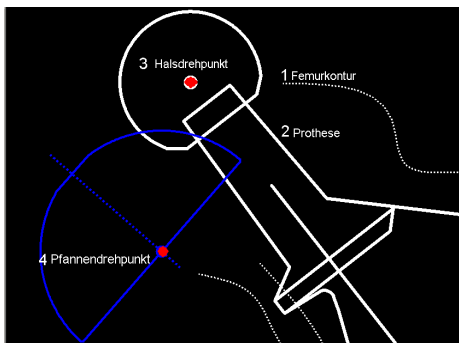
Note: With **Single Items** you can also delete labelling of prostheses.

Move, copy and rotate elements and prostheses

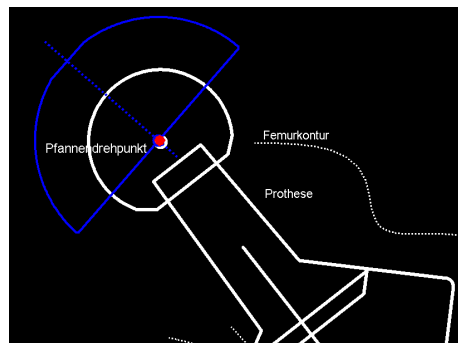
For example

The prostheses must be fitted in the cup in such a way that the center of rotation of the prostheses head and the cup center are congruent.

Pre-position



Post- position





Procedure

Click on **Move**




	L: Select element or define first corner of area	Move
	R: Exit function	
	M: Element or Line	

- L** ● With the left mouse button, select the elements you want to move or drag a window around them with the mouse pointer, e.g.
1st. element is the prostheses
2nd. element is the femur outline

	L: Select element or define first corner of area R: Finish selection M: Element or Line	Move
R	With the right mouse button, finish the selection process. Note: the selection of all elements to be moved has to be finished in order to go on with the procedure.	
	L: Grab point R: Exit function M: Free	Move
L	With the left mouse button, select the reference point, use the center point of the prostheses neck as a grab point.	
M	With mode Free you can position the cursor anywhere you choose. Note: press key P and change to mode Point . Drawing near to it, you can snap to the center point of the prostheses neck.	


The selected elements (e.g. the femur contour with the prostheses are connected) can be moved the mouse and rotated by pressing the key ← or →.


For changing the size of the prostheses press the keys ↑ or ↓.

	L: Destination point R: Back M: Free	Move
L	With the left mouse button, select the destination reference point, the center point of the cup. Align the selected objects in such a way that the point of references coincide.	
R	With the right mouse button you go back to the Module too .	
M	With mode Free you can position the cursor anywhere you choose. Note: Press key P and change to mode Point . Drawing near to it, you can snap to the rotation point of the cup.	

Changing text

Existing text, also automatically inserted text can be changed, moved and rotated.

Click on **Edit text** 

	L: Select text to edit R: Exit function M: Element or Line	Edit text
L	With the left mouse button select the text.	
L	With the left mouse button pickup the text, move, rotate it.	
L	With the left mouse button set it at the new position.	
R	With the right mouse button you quit this function.	

Change existing text



Select this function, click on the text you want to change or modify, the text tool opens automatically. Go to the text in the text tool and change it.

With the same function you can shift or rotate the existing text by clicking twice on it.

Write new texts



With the editor of the text tool, write and place your text.

Zoom Pan



Description of the function

When activating this icon (even while working in another function) you can grab and move the complete image.



You do not need to quit the function you were working with before. Use the Zoom Pan in addition to the other function.

NOTE: When you finished you have to quit the Zoom Pan with the **right** mouse click. Subsequently you continue working with in the module.

NOTE: At the same time you move the image, you can enlarge or scale down the image by scrolling the mouse wheel

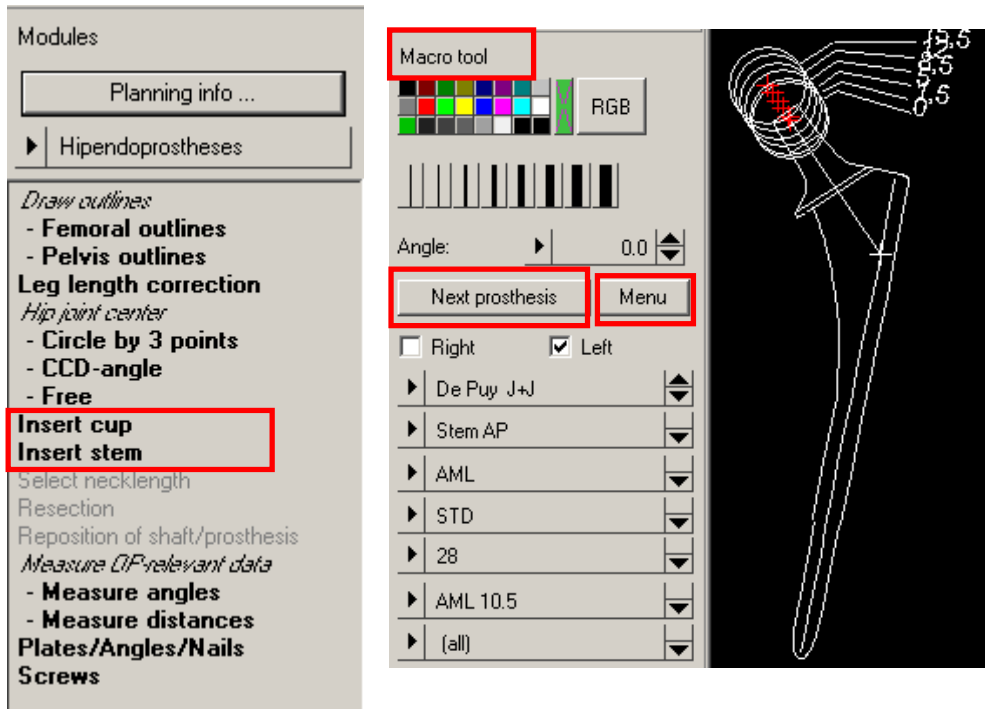
Procedure:

Activate the icon and proceed according to the order in the information area.

	L: Grab point R: Exit function M: Free	Zoom Pan
L ●	With the left mouse button, take the image /element and move to the required position.	
	L: Destination point R: Exit function M: Free	Zoom Pan
L ●	With the left mouse button, position the image at the destination.	
R ●	With the right mouse button you quit the function.	

NOTE: This function interrupts the procedure of all actual functions you are working on. In order to get back to the previous function you always have to exit the Zoom Pan with the right mouse button. Only then can you go on.

Insert a prostheses



Your database contains prostheses templates of various types, models and sizes from different manufacturers.

When you activate e.g. the function **Insert cup** the **Macro tool** for prostheses opens automatically. Attached to the mouse pointer is always the prostheses type you used last.

With the function **Next prosthesis** you add the next prostheses.

If you do not activate **Next prosthesis** and change type or size, the actual choice is attached to the mouse pointer.

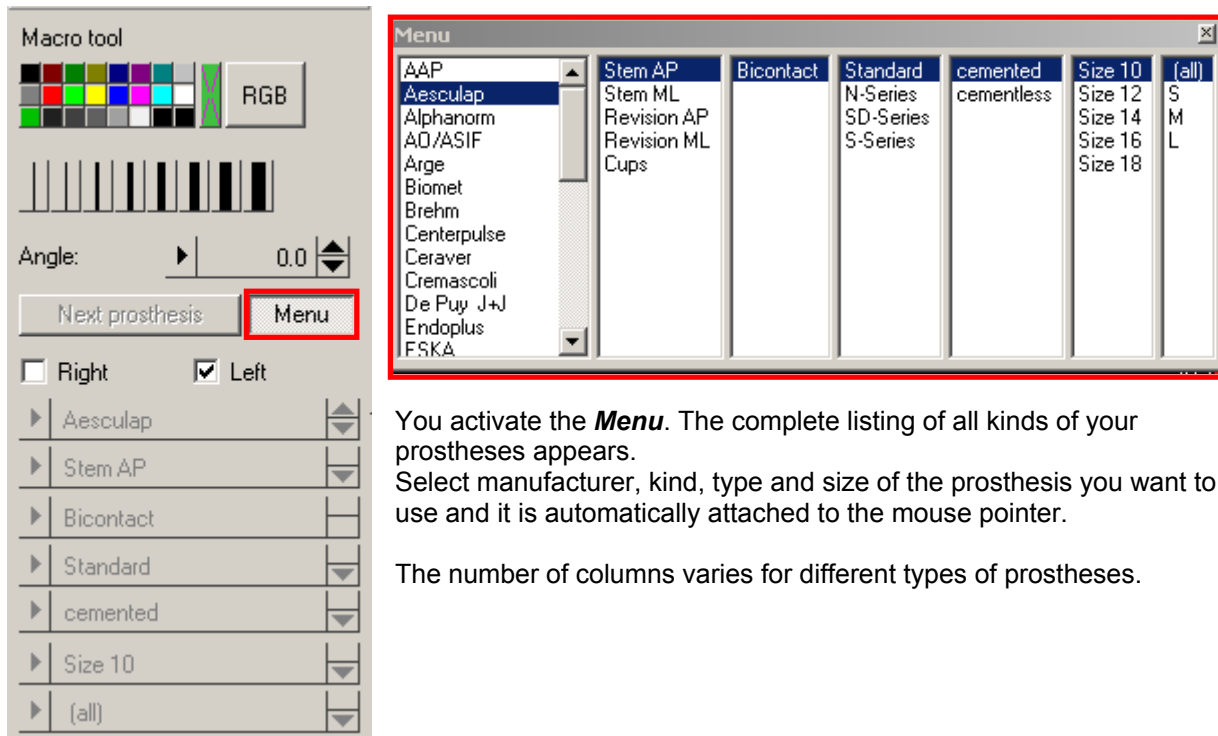
The **Orthopaedic Application** offers 2 kinds of selection:

- selection from a **Menu (listing)**
- or
- selection from a **pull-down-menu**

WARNING:

All dimensions and measurements given by the Orthopaedic Application prostheses database derive from original manufacturers data or templates. An exemption from liability exists for incorrect or false original prostheses manufacturer data.

Select from the **Menu** (listing)



You activate the **Menu**. The complete listing of all kinds of your prostheses appears. Select manufacturer, kind, type and size of the prosthesis you want to use and it is automatically attached to the mouse pointer.

The number of columns varies for different types of prostheses.

	L: Drag and drop macro	Macro tool
	R: Confirm macro	
	M: Free	

- L** ● With the left mouse button, position the prostheses.
- L** ● With the left mouse button, pick up the prostheses again and move it to another position.
If preliminary prostheses are set, you can change it by going to another prostheses of your choice inside the **Menu**.
- R** ● With the right mouse button, confirm the chosen prostheses and exit the function.

After you exit the function and want to change the prostheses again or to position it somewhere else, do so by using **Delete** or **Move**.

With the function **Next prosthesis**, add the next prosthesis while the previous prosthesis is finally positioned.

For example, choose a cup and position it. Go to **Next prosthesis** and choose the stem. Position it and confirm.

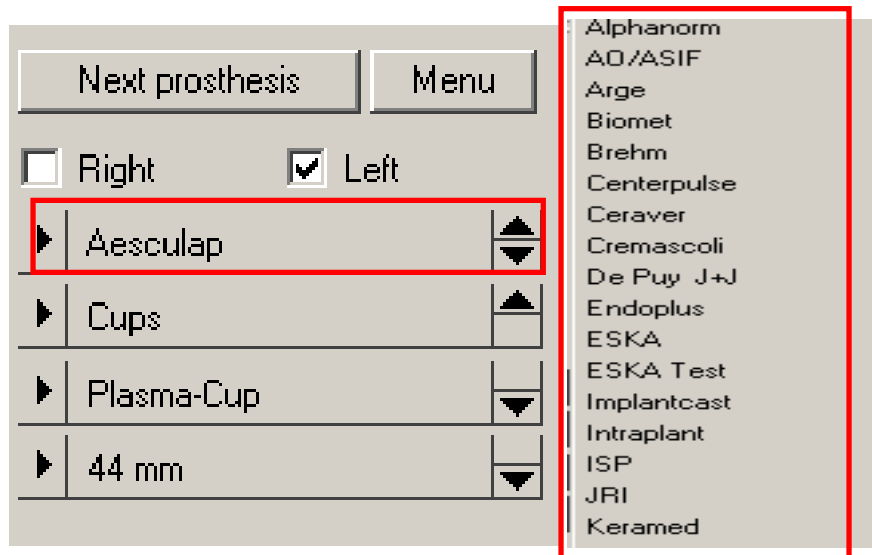
Note:

If the prosthesis is **not finally positioned**, you can move and rotate or even change the prostheses by picking it up by clicking on the left mouse button.

The prosthesis will be only applied after you have positioned it again (with the left mouse click) and then click on the right mouse key to confirm.

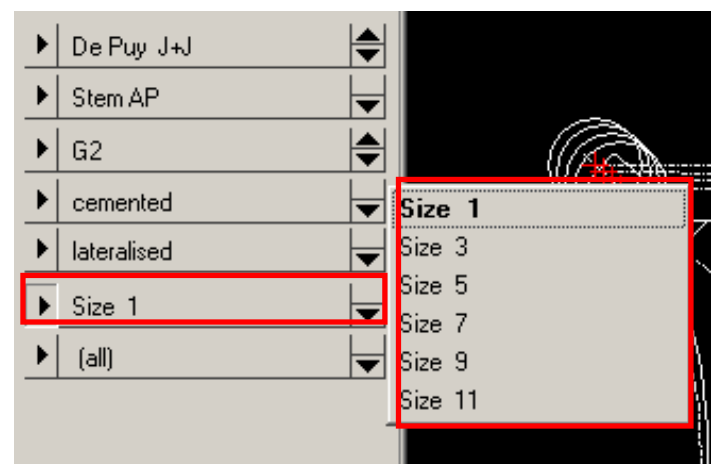
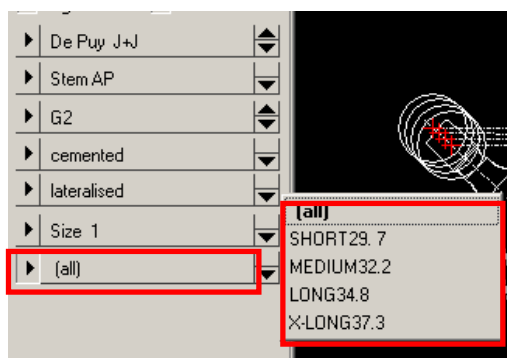
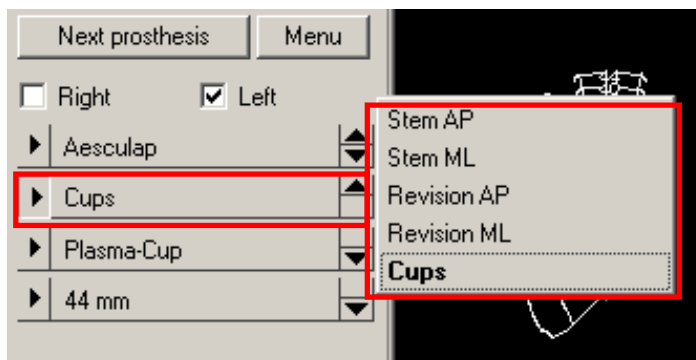
Exception: Screws always are to be positioned with a starting point and an endpoint. They have various lengths corresponding to the mouse position and are set with the endpoint. If positioned, you cannot move them any more. Changing the screw position can only be done using **Delete** and inserting a new one or by using **Move**.


Selection from the *pull-down menu*



by clicking on one of the different items:
manufacturer
kind of prosthesis
type of prosthesis
size of prosthesis

The next window opens for further selection. There is not set sequence. The result of your selection is shown automatically at the mouse pointer and on the **Macro tool**.



	L: Drag and drop macro R: Confirm macro M: Free	Macro tool
-----------------------------------------------------------------------------------	-------------------------------------------------------	------------

- L●** With the left mouse button, position the prostheses
- L●** With the left mouse button, pick up the prostheses again and move it to another position.
If a preliminary prosthesis is set, you can change it by going to another prostheses of your choice inside the **Menu**.
- R●** With the right mouse button, confirm the chosen prostheses and exit the function.

After you exit the function and want to change the prosthesis again or to position it somewhere else, do so using **Delete** or **Move**.

With the function **Next** prosthesis, add the next prosthesis while the previous prosthesis is positioned. For example, choose a cup. Position it and go to **Next prosthesis**. Choose the stem and position it and confirm.



NOTE:

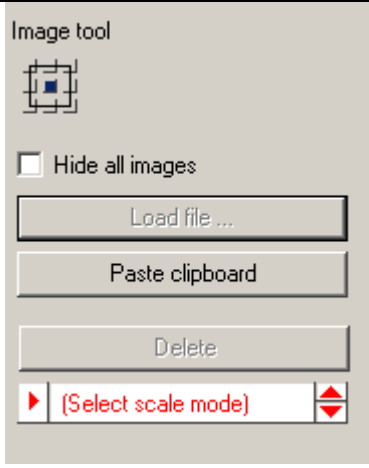
If the prosthesis is **not finally confirmed**, you can move and rotate or even change the prosthesis by picking it up by clicking the left mouse button.

The prosthesis will be only confirmed after you have positioned it and then clicked on the right mouse key

Exception: Screws always are to be positioned with a starting point and an endpoint. They have various lengths corresponding to the mouse position and are set with the endpoint. If positioned, you cannot move them any more. Changing the screw position can only be done using **Delete** and inserting a new one or by using **Move**.

Horizontal toolbar

<p>New</p>  <p>Moduls</p> <p>Planning info ...</p> <p>▶ Hip-Endoprosthesis</p> <p><i>Trace outlines</i></p> <ul style="list-style-type: none"> - Femoral outlines - Pelvis outlines <p>Leg length correction</p> <p><i>Define hip joint center</i></p> <ul style="list-style-type: none"> - Circle by 3 points - CCD-angle - Free <p>Insert ...</p>	<p>New</p> <p>Open a new document to write your planning. Simultaneously you can load and work on several documents with various or identical original images (DICOM, bmp, etc.) or plannings (mpl= <i>Orthopaedic Application</i> planning format).</p> <p>Planning information You get a mask with patient relevant data.</p> <p>Module tool With this tool, choose the required module to work with. e.g. Hipendoprosthesis or Coxometry or...</p>
<p>Modules</p> <p>Coxometry</p> <p>Elbow</p> <p>Hipendoprosthesis</p> <p>Hipendoprosthesis/Biometry</p> <p>Knee</p> <p>Osteotomy</p> <p>Osteotomy Dror Payley</p>	<p>Modules</p> <p>Choose the required module.</p>
<p>Insert Images</p> 	<p>Insert Images</p> <p>Opens original images without any plannings of the following types: JPG (.jpg, .jpeg), Bitmap (.bmp), DICOM (.dcm), TIFF (.tif, .tiff) After loading, each original image has to be scaled.</p>



Warning: You can only scale the image correctly if a scale bar or a scaling sphere was placed in the image area while the image was exposed. Check your measurements carefully. False values can have serious consequences for the patient regarding misinterpretations of the right prostheses size.

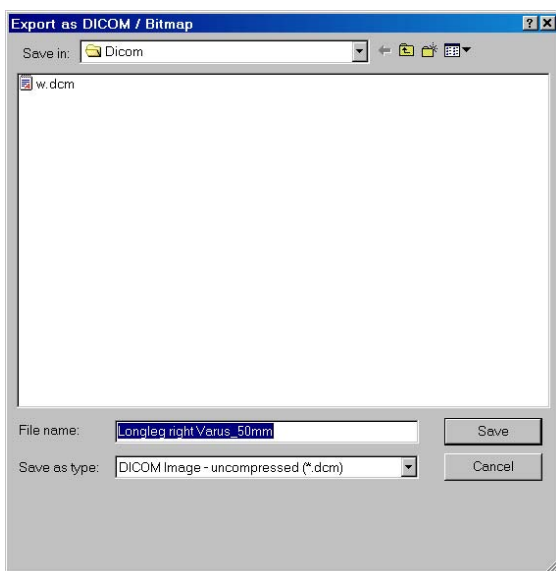


Image tool

Defined alignment of the image on the screen.
Hide all images fades out the x-ray in order, only the graphics of the *Orthopaedic Application* are still visible.


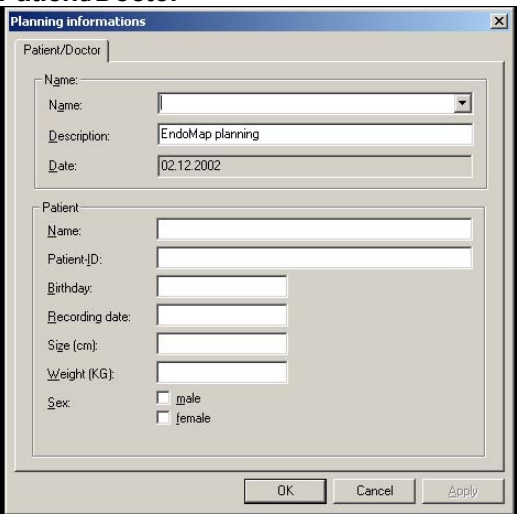
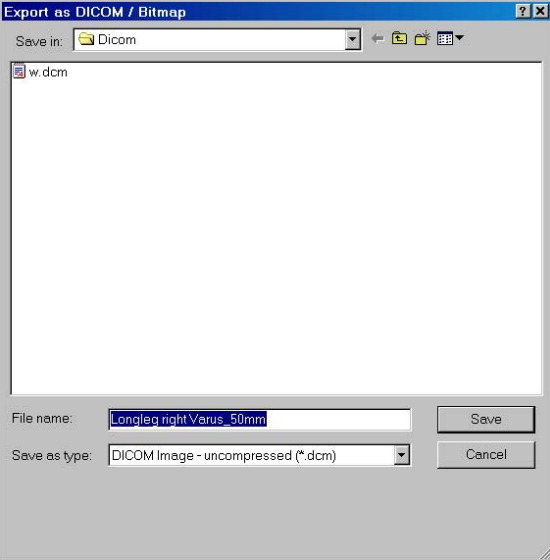

Open the dialog window to choose an image.
 Load an image from a file.
 Pastes an image out of a clipboard.
 Delete selected images.

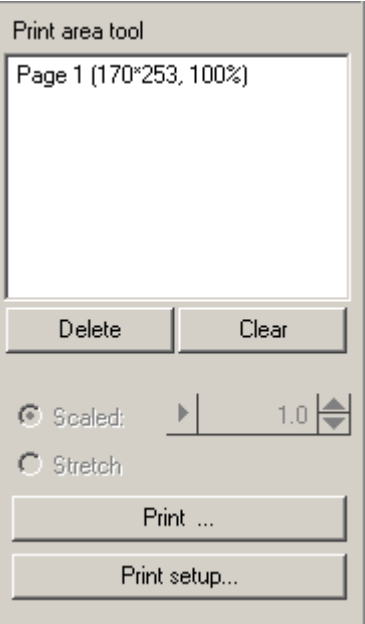


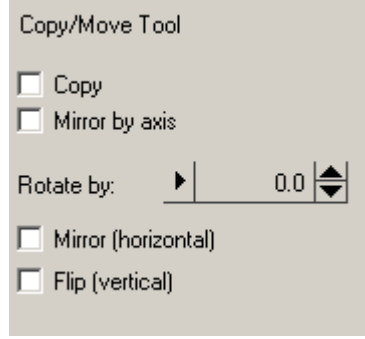
After loading an image the **Select scale mode** blinks.
 Choose the required mode and scale the image.
 Without this calibration, you cannot continue to work.




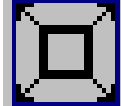

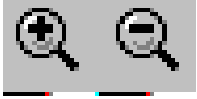
If you need another link to a store, define your actual register name, file name, and type of data format.

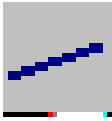
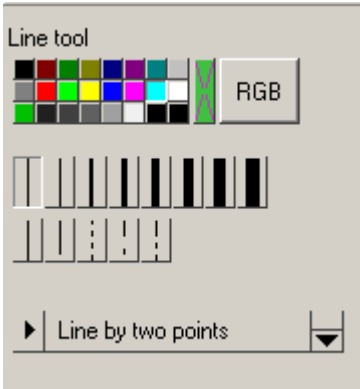

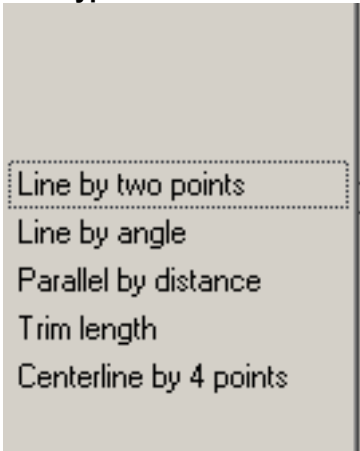
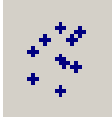
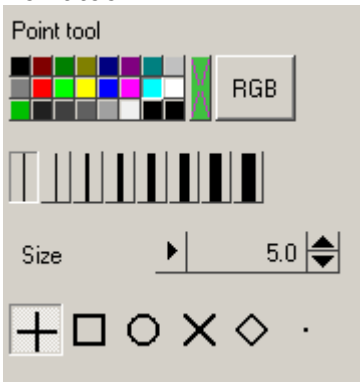

Open


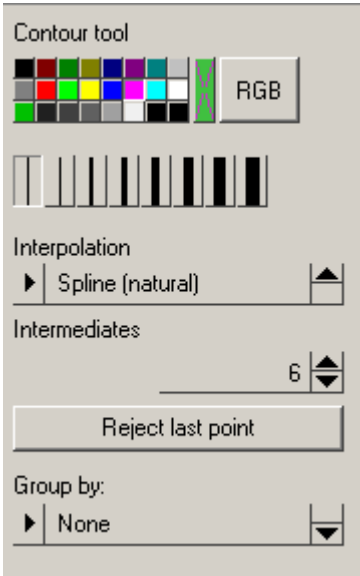
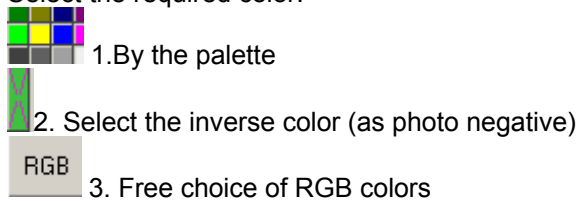
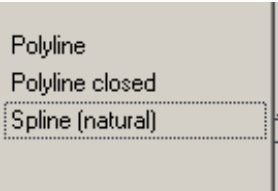

Open an image including a planning with graphics to continue, to correct, to complete or to view.
 Load the planning (mpl data format) from your local hard disk or from a network.

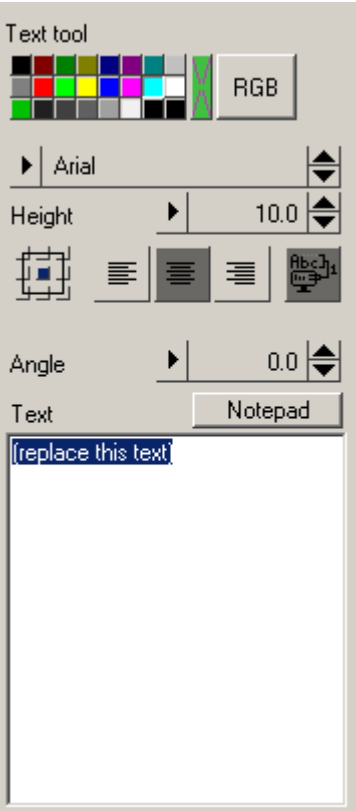



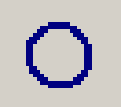
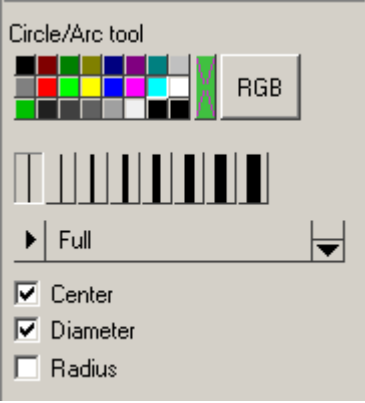



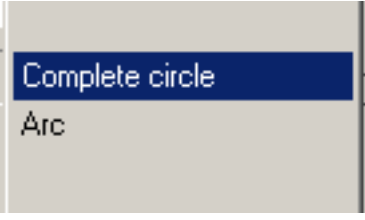
<p>Save</p> 	<p>Save</p> <p>Save your planning including all planning information in a defined file system.</p> <ol style="list-style-type: none"> 1. To continue your work at a later date, save the planning drawings as an mpl file in the file system on your PC. 2. If the planning is completed transfer it DICOM to the database on your PACS System workstation. <p>Now your planning is finally saved a document and not changeable later on.</p>
<p>Patient/Doctor</p> 	<p>Patient/Doctor</p> <div style="background-color: yellow; border: 1px solid black; padding: 5px;"> <p>Warning: Check all items very carefully; false information may cause severe problems. The following details have to be filled in always: doctor name patient name patient date of birth</p> </div> <p>Working with the module Biometry, add information for size and weight of the patient.</p> <p>Working with the module Coxometry, add the recording date of the image.</p>
<p>Export as DICOM / Bitmap</p> 	<p>If you save the planning as DICOM to the database on your PACS System, the planning is finally stored and not changeable later on.</p> <p>Procedure: Go to the menu bar and click on File. Activate the function Export as DICOM/image. Choose the right data format and type in the file name you want to use.</p> <div style="background-color: yellow; border: 1px solid black; padding: 5px;"> <p>Warning: Choose a name that ensures an unambiguous connection between the planning data and the patient. e.g. patient name + date of birth</p> <p>Prove all data carefully. Incorrect assignment between the drawing and the patient can have serious consequences for the patient.</p> </div>
<p>Print</p> 	<p>Print</p> <p>Printing of one or more planning documents.</p>


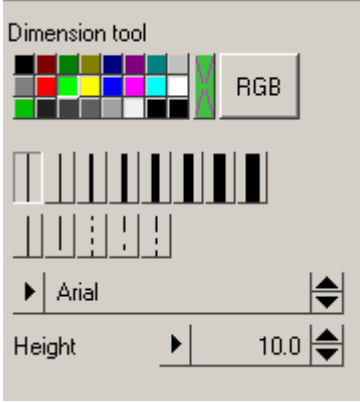


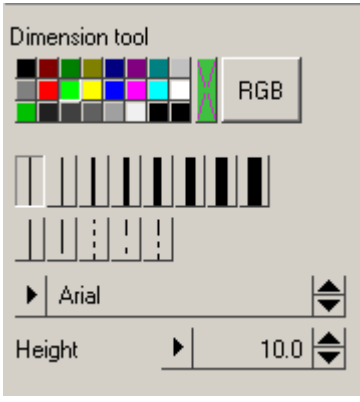
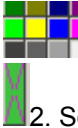

<p>Print area tool</p> 	<p>Print area tool</p> <p>Already defined print areas:</p> <p>Delete marked print areas. Clear delete all print areas.</p> <p>Scaled: Determines the size of the image section that will be printed when you click on the Print button. The larger the magnification factor, the smaller the printed image section will be.</p> <p>Stretch: The section to be printed can be chosen as required.</p> <p>Print: Print the defined section.</p> <p>Print setup: opens the standard Print Setup dialog window.</p>
<p>Select Size(Shaft/Head/..)</p> 	<p>Select Size(Shaft/Head/..)</p> <p>This function selects the sizes of hip heads or width of stems or nails, length or width.</p>
<p>Move/Copy/Mirror/Rotate</p> 	<p>Move/Copy/Mirror/Rotate</p> <p>The required object can be moved, copied, mirrored and rotated according to the functions chosen with the Copy/move tool.</p>
<p>Copy/move tool</p> 	<p>Copy/move tool</p> <p>The shown functions can be used single or in combination.</p> <p>Copy: Mirror the required objects and display it in addition to the original.</p> <p>Move Used as a single function, the required object is moved to another position. Used in combination with another function the object is copied and mirrored by an axis.</p> <p>Mirror by axis The required object can be mirrored by an axis, which you define.</p> <p>Mirror horizontal or flip vertical Displays the required object above or below of the original.</p>

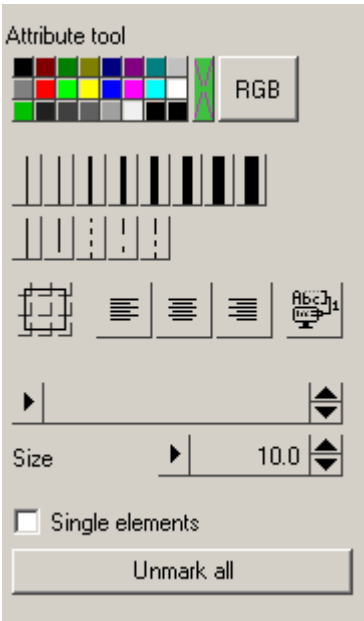



<p>Delete</p>  <p>Delete tool</p> <p><input checked="" type="checkbox"/> Single items</p> <p>(select group)</p> <p>Delete group</p>	<p>Delete</p> <p>Deleting groups or single elements.</p> <p>Objects consists of several elements. Several elements may belong to a group. E.g. a template and the label. Or a template (Macro) consists of several lines (elements).</p> <p>If Single items is activated you can delete single elements as labels or lines or measurements.</p> <p>Select group means to select the required group (macro). Deletes the selected group.</p>
<p>Undo and redo</p> 	<p>Undo and redo (Cancel and restore)</p> <p>You can undo as many steps you want. Redo means to restore the cancel steps.</p> <p>Same functions are activated by keys: Press u for <i>undo</i> or press shift u to restore the last cancelled step.</p>
<p>Zoom all</p> 	<p>Zoom all</p> <p>The size of the planning image is adjusted to fill the display area.</p> <p>Same functions are activated by keys: Press A for all.</p>
<p>Zoom rectangular</p> 	<p>Zoom rectangular</p> <p>You can enlarge a certain section of an image by using the mouse to drag open a box covering the required image section.</p> <p>Same functions are activated by keys: Press w for <i>window</i> and draw the rectangular.</p>
<p>Zoom Pan</p> 	<p>Zoom Pan</p> <p>Drag and drop the image to a new position.</p> <p>Simultaneously you can enlarge/scale down the image with the scroll wheel of your mouse or with the keys:</p> <p>+ and -</p>
<p>Zoom in and Zoom out</p> 	<p>Zoom in and Zoom out</p> <p>The screen is enlarged or scaled down step by step.</p> <p>Same functions are activated by keys</p> <p>+ and - or by the scroll wheel of your mouse.</p>

<p>Lines</p> 	<p>Drawing lines</p> <p>You can draw several kinds of lines.</p>
<p>Line Tool</p> 	<p>Line Tool</p> <p>Select the required color:</p>  <ol style="list-style-type: none"> 1. By the palette 2. Select the inverse color (as photo negative) 3. Free choice of RGB colors <p>Choice of line width.</p> <p>Choice the line type.</p>
<p>Line type</p> 	<p>Line types:</p> <p>Line with a starting and terminator point.</p> <p>Line in a defined angle to a reference line. The angle is your choice.</p> <p>Parallel line in a defined distance to a reference line. The distance in mm is your choice.</p> <p><i>Trim:</i> change line length.</p> <p>An axis or midline is drawn automatically defined by 4 points surrounding it.</p>
<p>Points</p> 	<p>Draw points</p> <p>All kinds of points can be drawn.</p>
<p>Point tool</p> 	<p>Point tool</p> <p>Select the required color:</p>  <ol style="list-style-type: none"> 1. By the palette 2. Select the inverse color (as photo negative) 3. Free choice of RGB colors <p>Choice of line width.</p> <p>Choice of size.</p> <p>Type of the point, single or in combination.</p>

<p>Outlines</p> 	<p>Draw outlines</p> <p>Drawing of contours for pelvis, femur, tibia or other bone outlines.</p>
<p>Contour tool</p> 	<p>Contour tool</p> <p>Select the required color:</p>  <ol style="list-style-type: none"> 1. By the palette 2. Select the inverse color (as photo negative) 3. Free choice of RGB colors <p>Choice of line width.</p> <p>Choice of the contour type:</p>  <ul style="list-style-type: none"> - Polyline - Polyline closed - Spline (natural) <p>Intermediates: means how accurate the spline is drawn. This value is preinstalled.</p> <p>Reject last point. NOTE: the same function you can activate by pressing the backspace-key (above the return key).</p> <p>Group by Define the Group to which the drawn contour should belong. Several single contours will be arranged to a group (group=macro). The group has to be defined before you start drawing the outline.</p> <p>Note: Together with the <i>Modules tool</i> the group is preinstalled: If you want to correct a line from a group afterwards, you have to activate the right group to which the corrected line should belong. You work with the module <i>HIP Module</i></p> <ul style="list-style-type: none"> 1st. group = femur shaft 2nd group = pelvis
<p>Create Text + and Edit Text</p> 	<p>Create text New text can be written.</p> <p>Edit text Existing texts can be changed, completed, moved or rotated.</p>

<p>Text tool</p> 	<p>Text tool</p> <p>Select the required color:</p>  <p>1. By the palette</p>  <p>2. Select the inverse color (like photo negative)</p>  <p>3. Free choice of RGB colors.</p> <p>Chooses the type of characters.</p> <p>Define the size of characters.</p> <p>Choose the block- or text adjustment.</p> <p>The text changes proportionally to the zoom in or zoom out of the image section or the size of the text does not change when you zoom in or zoom out.</p> <p>Define the angle of rotation for the text.</p> <p>Notepad an additional section of an editor opens to edit more text.</p> <p>Small editor segment.</p>
<p>Circles</p> 	<p>Circles</p> <p>Drawing of circles and arcs.</p>
<p>Circles/arc tool</p> 	<p>Circles/arc tool</p> <p>Select the required color:</p>  <p>1. By the palette.</p>  <p>2. Select the inverse color (like photo negative)</p>  <p>3. Free choice of RGB colors.</p> <p>Define the size of the line.</p> <p>Choose a complete circle or only an arc. See below.</p> <p>Choose additional to the circle the center point, the diameter or the radius. The functions can be combined.</p>
	<p>A complete circle has 360°</p> <p>An arc can be created out of a complete circle. The required arc is generated by drawing the required segment antilock wise to the circle. The not required segment of the circle will be deleted.</p>

<p>Dimension parallel</p> 	<p>Draw dimensions parallel</p> <p>Insert a dimension.</p>
<p>Dimension tool</p> 	<p>Dimension tool</p> <p>Select the required color:</p>  <ol style="list-style-type: none"> 1. By the palette. 2. Select the inverse color (like photo negative) 3. Free choice of RGB colors. <p>Define the size of the line.</p> <p>Choose the type and size.</p>
<p>Dimension angle</p> 	<p>Dimension angle</p> <p>Define the dimension of an angle.</p> <p>NOTE: Angles are always defined anticlock wise to the reference lines.</p>
<p>Dimension tool</p> 	<p>Dimension tool</p> <p>Select the required color:</p>  <ol style="list-style-type: none"> 1. By the palette. 2. Select the inverse color (like photo negative) 3. Free choice of RGB colors. <p>Define the size of the line.</p> <p>Define type and size of the text.</p>
<p>Attributes</p> 	<p>Attributes</p> <p>Function to change the characteristics of a line, a point, an element or a macro.</p> <p>Note: Text can only be changed by the text tool!</p>

<p>Attribute tool</p> 	<p>Attribute tool</p> <p>Select the required color:</p>  <ol style="list-style-type: none"> 1. By the palette. 2. Select the inverse color (like photo negative) 3. Free choice of RGB colors. <p>Define the size of lines.</p> <p>Choose the block or text adjustment if active.</p> <p>The text changes proportionally to the zoom in or zoom out of the image section or the size or not.</p> <p>Text size can be changed.</p> <p>If activated, colors and size of single elements like labels on prostheses or single lines of prostheses or single lines of contours can be changed.</p> <p>Marked objects can be unmarked all at once.</p>
<p>Allow/disallow Fixed font sizes</p> 	<p>Allow/disallow fixed font sizes</p> <p>Choice of the function to change/not to change the text proportionally to the zoom in or zoom out of the image section.</p> <p>If this function is activated all text blocks are displayed in the preselected size, independent of the zoom in or zoom out.</p>
	<p>Im/Export into a temporary store for later transfer into the archive. This function has to be installed by the administrator following the PACS installation instructions.</p>

Explanation of Fixed font size

In general the size of a text is zooming in/out when the image section is zoomed in/out.

If a text has the attribute **Fixed font size** there is no change of that size by zooming in or out of the image section.

The advantage is that you always can comfortably read the text.

The *Orthopaedic Application* has preinstalled **Fixed font sizes** for the prostheses labels and the measurements. This you may change with the **Attributes tool** or the **Text tool**.

The meaning of Fixed font size

Where is the function relevant?

The feature **Fixed font size** can be activated or not for:

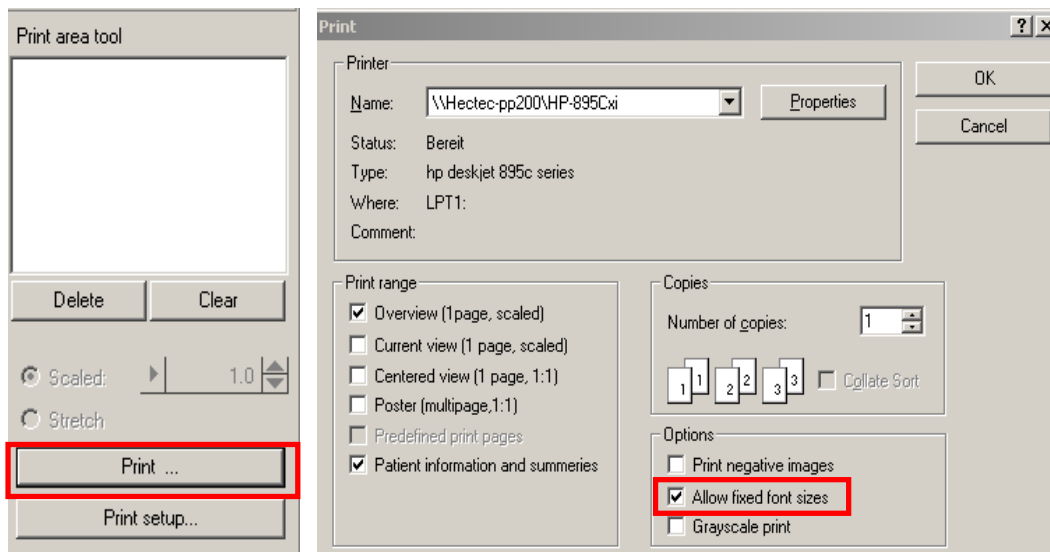
- the screen
- the printer
- and the image export

Where can the function be set?

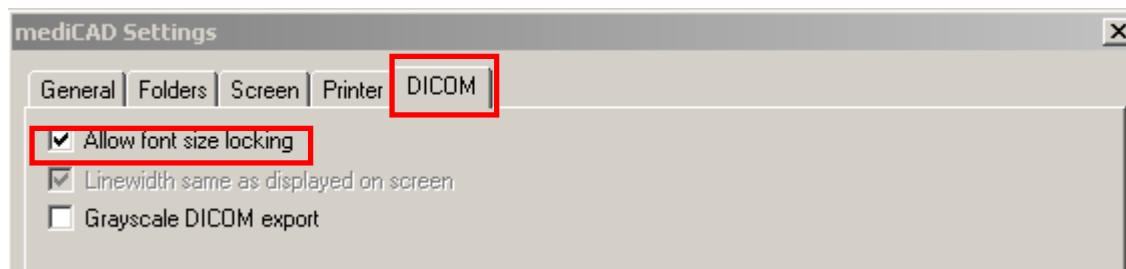
For the **screen**, activate the function with the **Horizontal Toolbar**.



For the **printer**, activate the function with the **Print area tool** and the function **Print**.



For **DICOM-/Image-export**, activate the function with the **Menu bar** → **File** → **Settings**.



Which settings are effective when installed?

The original settings of the *Orthopaedic Application* are:

- for the screen **Fixed font size** are allowed (activated)
- for print **Fixed font size** are not allowed (deactivated)
- for DICOM-/Image-Export **Fixed font size** are allowed activated)

You decide yourself which settings are the best for your work with the *Orthopaedic Application*. The settings you made last are stored and remain activated for the next program start.

Procedures step by step

Osteotomy II

Basics

The module Osteotomy II calculates and corrects one or multiple deformations at the lower limbs.

The size of the osteotomy angle is either calculated automatically by the **Orthopaedic Application** to achieve an optimal axis situation or is to be evaluated manually by the physician.

By analysing the relative positions of malalignment in the AP and Sagittal view, you can calculate automatically the APEX to the sagittal plane and the real deformity angle.

The right osteosynthetic components like nails, plates and screws can be selected very easy out of a database.

Advantages:

- The outlines of femur and tibia have to be drawn only once.
- The actual situation of all axes is calculated and displayed automatically.
- Simulations of different conditions can be displayed in one planning session in order to achieve the most optimal result for the patient.
- Minimal effort is required.

Loading images into the Orthopaedic Application

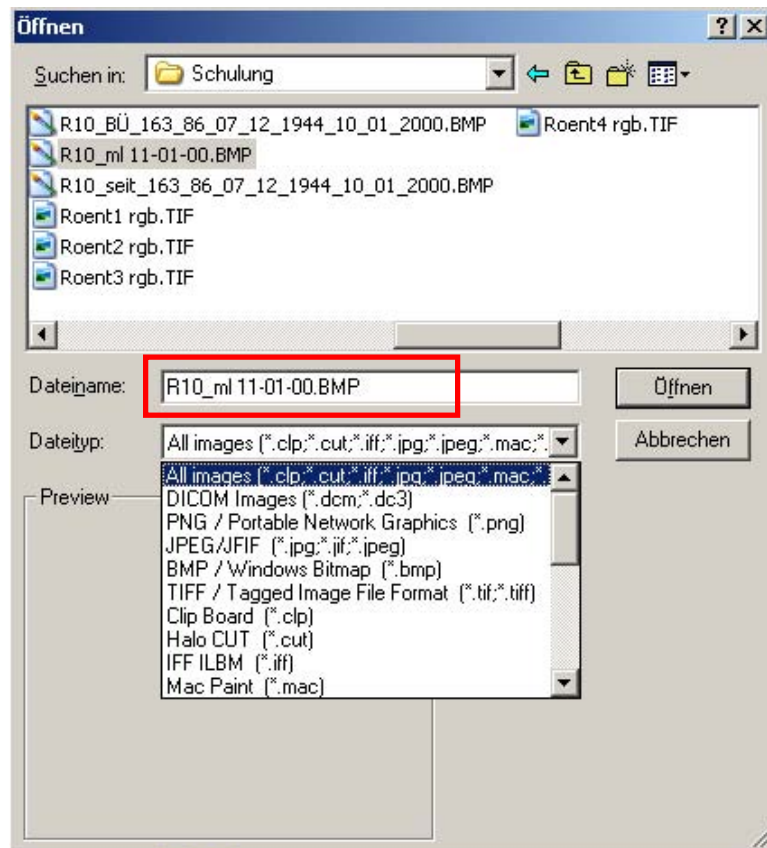
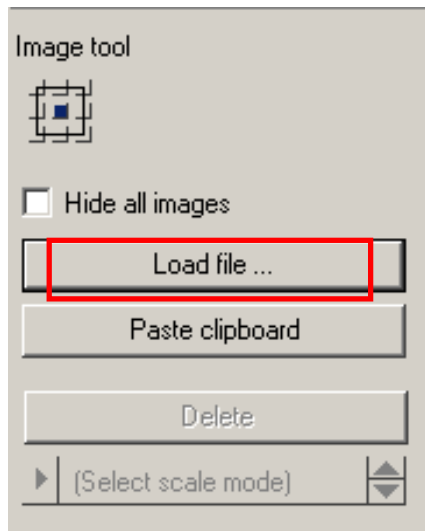


The following steps are necessary:

1. Activate the function **Images** to load and scale an image
2. Select the first image from where it is stored. Regard the right file format.
3. The *Orthopaedic Application* prompts you to **scale** the image. Continue the process until all of the individual images you want to compose are loaded in the *Orthopaedic Application*.

NOTE: The larger you display the reference scale during scaling, the more precisely you can assemble the individual image later.

4. Click on the images one after the other and move it to the required position. Continue doing this until the images are correctly positioned.
5. Save the resulting intermediate image temporarily as an *Orthopaedic Application* planning file **.mpl** to your local hard disk.

**Warning:**








Any axial malalignment can only be calculated correctly if the images used for planning satisfy the following requirements:

A-P image showing one leg only (taken of both legs) or showing both legs in a standing position with equal load.

Hip joint and ankle joint visible in full.

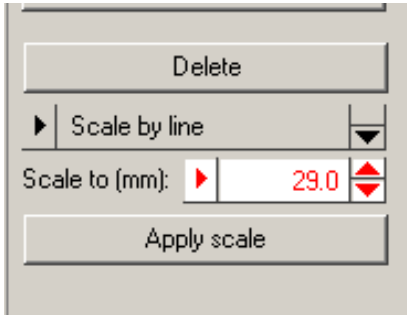
A lead scale is shown on the image (or each part of the image to be supposed to planning) at the height of the longitudinal axes of femur or tibia for calibration purposes.

Procedure with an ap (anterior/posterior) view

 <p>Select the image and scale it.</p> <p>or</p>  <p>Select an image that is already complete and scaled. In this case Step 2 + 3 is not necessary.</p>	<p>Step 1 Select image 1</p>
 <p>L: Select image to move or to scale R: Exit function M: Element or Line</p> <p>L ● With the left mouse button, take the image and position it. R With the right mouse button, exit the function. M Not relevant.</p>	
<div style="display: flex; justify-content: space-between;"> <div data-bbox="253 588 576 1003" style="border: 1px solid gray; padding: 5px;"> <p>Image tool</p>  <p><input type="checkbox"/> Hide all images</p> <p>Load file ...</p> <p>Paste clipboard</p> <p>Delete</p> <p>(Select scale mode)</p> </div> <div data-bbox="682 619 1372 661"> <p>The function Select scale mode is activated and flashes.</p> </div> </div> <p>Select the scale mode and scale the image with the reference visible on the screen.</p> <div data-bbox="690 766 1047 976" style="border: 1px solid gray; padding: 10px; text-align: center;"> <p>Scale by line</p> <p>Scale by circle</p> </div> <p>Scale with the aid of a distance line, if a scale bar is visible on the screen.</p> <p>Scale with the aid of a circle by 3 points, if a scaling sphere is visible on the screen</p>	<p>Step 2 Select scale mode 2</p>
 <p>L: 1. Point R: Cancel scaling M: Free</p>	<p>T:\mediCAD\bilder\perthes\Bild16.bmp</p>
<p>L ● With the left mouse button, define the first point of a line or the edge of a circle.</p> <p>R With the right mouse button, exit the function.</p> <p>M Define the position of the point Free of your choice.</p>	
 <p>L: 2. Point R: Back M: Free</p>	<p>T:\mediCAD\bilder\perthes\Bild16.bmp</p>
<p>L ● With the left mouse button, define the second point of a line or the edge of a circle.</p> <p>R With the right mouse button, go back to the first point.</p> <p>M Define the position of the point Free of your choice.</p>	
<p>If you scale with the aid of a line – scaling now is done, confirm with Enter If you scale with the aid of a circle complete the circle with the third point.</p>	
 <p>L: 3. Point R: Back M: Free</p>	<p>T:\mediCAD\bilder\perthes\Bild16.bmp</p>
<p>L ● With the left mouse button, define the third point of the edge of a circle.</p> <p>R With the right mouse button, go back to the first point.</p> <p>M Define the position of the point Free of your choice.</p>	

Step 3 Scaling measurement in mm **3**

Fill in the correct measurement of the reference and confirm with **Apply scale** or **Enter**.



Warning: You can only scale the image correctly if a scale bar or a scaling sphere was placed in the image area while the image was exposed. Check your measurements carefully. False values can have serious consequences for the patient regarding misinterpretations of the right prostheses size.

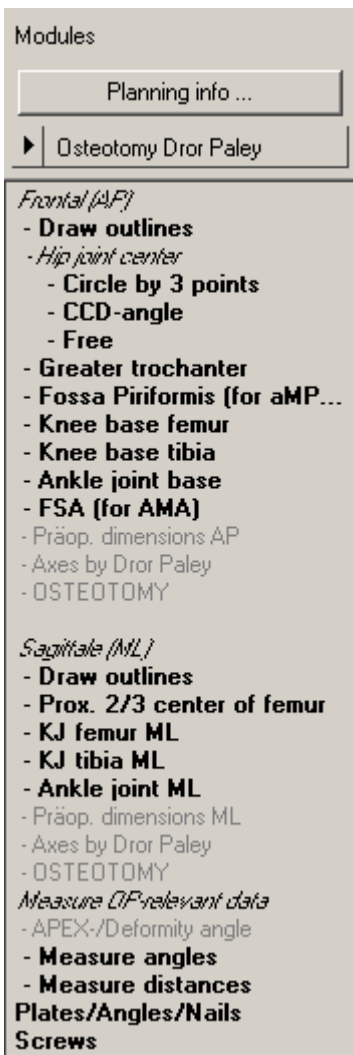
Note:

After you scaled the image correctly press the right mouse button to exit the function.



The image is now scaled 1:1. Start with planning.

Step 4 Select module **4**



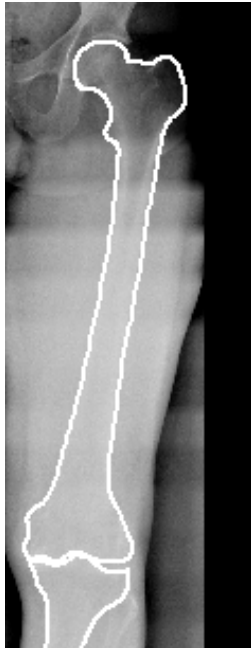
Choose the desired module to work with.

The **Osteotomy II** is activated. You can exit this module at any time in order to select another module

By activating the next steps of the menu, the right function tool opens automatically and you are guided by the **Information bar**.

The support given by the **Information bar** is described next.

Trace outlines
- Femoral outlines
- Tibial outlines
Define hip joint center



Requirements: A scaled image of a long leg
Result: The femoral and the tibial outline are drawn by individual points along the outer corticalis.

You are in the function **Trace outlines**

CAUTION: Distinguish between femoral and tibial outline when activating the function in each case. If both outlines are drawn with the same function a rotation of the femur against the tibia is **not** possible.

After selecting the color and the size of the line, click consecutively along the contour. The spline function requires less intermediate points for straight lines than for curves. **Note:** To reject points go to the function **Reject points** or press the backspace key (above return). **Reject last point** step by step and then continue drawing.

	L: first point R: Exit function M: Free	Contours
--	-----------------------------------------------	----------

- L** ● With the left mouse button, define the first point of the femur outline, e.g. you start drawing the lateral outer corticalis.
- R** With the right mouse button, exit the function.
- M** Define the position of the point **Free** of your choice.

	L: next point R: next contour M: Free	Contours Press backspace to reject the last point
--	---------------------------------------------	------------------------------------------------------

- L** ● With the left mouse button, define the next point of the outline.
- R** With the right mouse button, finish the line.
- M** Define the position of the point **Free** of your choice.
- R** ● With the second mouse click, go back to the **Module tool**.

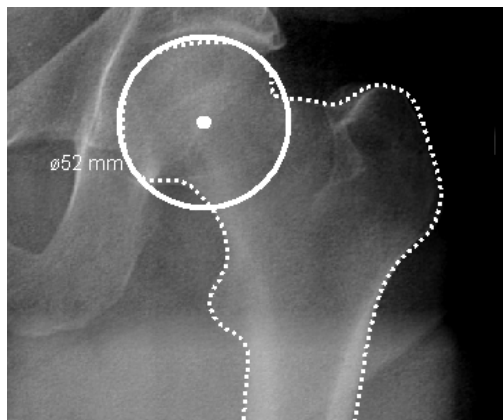
You draw the outer corticalis of tibia the in the same way

After exit the function go back to the **Module tool** and choose the next fat written function.

Step 6 Define hip joint center (HJC) **6**

- Define hip joint center
- Circle by 3 points
 - CCD-angle
 - Free

Requirements: a scaled image
Results: a circle will be drawn by 3 points, the circle and the diameter in mm temporary appears, the center point of the circle is defined and drawn.



You are in the function **Circle by 3 points (HJC)**. After selecting the kind, color, and the size of the line, start drawing the circle.

	L: 1. Point R: Exit function M: Free	HJC by 3 points
--	--------------------------------------------	-----------------

- L** ● With the left mouse button, define the 1st point on the edge of the hip head.
- R** With the right mouse button, exit the function.
- M** Define the position of the point **Free** of your choice.

	L: 2. Point R: Back M: Free	HJC by 3 points
--	-----------------------------------	-----------------

- L** ● With the left mouse button, define the 2nd point on the edge of the hip head.
- R** With the right mouse button, go back to point 1.
- M** Define the position of the point **Free** of your choice.

	L: 3. Point R: Back M: Free	HJC by 3 points
--	-----------------------------------	-----------------

- L** ● With the left mouse button, define the 3rd point on the edge of the hip head.
- R** With the right mouse button, go back to point 1.
- M** Define the position of the point **Free** of your choice.

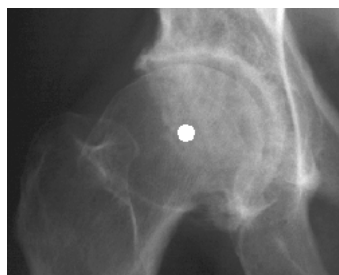
The hip joint center point is displayed.

<p>Define hip joint center - Circle by 3 points - CCD-angle - Free</p>	<p>Requirements: A scaled image. Result: With the function FSA (femur shaft axis) by 4 points the CCD angle (84°/130°) is drawn and the HJC (hip joint center) will be defined.</p>	<p>6a</p>
	<p>L: Define 1. of 4 points R: Exit function M: Free</p> <p style="text-align: right;">FSA by 4 points</p>	
<p>L R M</p>	<p>With the left mouse button, define point 1. E.g. the distal, lateral inner corticalis. With the right mouse button, go one step back. Define the position of the point Free of your choice.</p>	
	<p>L: Define 2. of 4 points R: Back M: Free</p> <p style="text-align: right;">FSA by 4 points</p>	
<p>L R M</p>	<p>With the left mouse button, define the point 2, which has to be opposite point 1. With the right mouse button, go back to point 1. Define the position of the point Free of your choice.</p>	
	<p>L: Define 3. of 4 points R: Back M: Free</p> <p style="text-align: right;">FSA by 4 points</p>	
<p>L R M</p>	<p>With the left mouse button, define point 3. E.g. the proximal, lateral inner corticalis. With the right mouse button, go back to point 2. Define the position of the point Free of your choice.</p>	
	<p>L: Define 4. of 4 points R: Back M: Free</p> <p style="text-align: right;">FSA by 4 points</p>	
<p>L R M</p>	<p>With the left mouse button, define the point 4, which has to be opposite point 3 With the right mouse button, go back to point 3. Define the position of the point Free of your choice.</p>	
<p>The femoral shaft axis is displayed. One line intersecting the femoral shaft axis in an angle of 84° and a second line intersecting the femoral shaft axis in an angle of 130° is attached to the mouse pointer.</p>		
	<p>L: Place hip joint center R: Exit function M: Free</p> <p style="text-align: right;">HJC (84.0°/ FNA 130.0°)</p>	
<p>L R M</p>	<p>Move the mouse until one line touches the tip of the trochanter major and the other line is symmetrical through the femoral neck. The mouse pointer indicates now the hip joint center. With the right mouse button, exit the function. The FSA remains drawn. Define the position of the point Free of your choice.</p>	
<p>The hip joint center, the femoral shaft axis and the lines indicating the CCD angle are displayed.</p>		

6b

Define hip joint center
 - Circle by 3 points
 - CCD-angle
 - Free

Requirements: a scaled image
Result: With this function you define the position of the HJC (hip joint center) **Free** of your own choice.



After selecting the kind, color, and size of the point, define the position of the HJC of your own choice.

L: Place HJC free
 R: Exit function
 M: Free

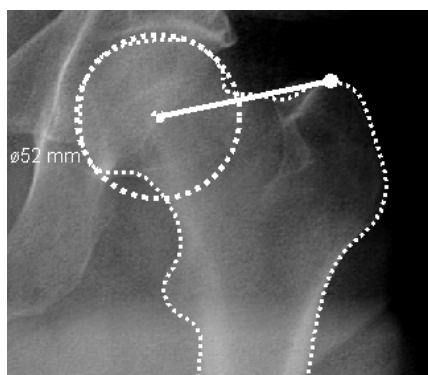
- L** ● With the left mouse button, define the position of the point.
- R** With the right mouse button, exit the function.
- M** Define the position of the point **Free** of your choice.

The hip joint center is displayed.

Step 7 Select Trochanter Major **7**

Greater trochanter
 Knee base femur

Requirements: A hip joint center is displayed.
Results: A connecting line between the hip joint center and the most cranial point of the greater trochanter is displayed. The direction of this line defines for the *Orthopaedic Application* the body side.



The function **Trochanter major** is activated.
 After selecting the kind, color, and size of the line, start drawing the connecting line.
 The starting point is automatically the hip head center.

L: Place greater trochanter Greater trocha
 R: Exit function
 M: Free

- L** ● With the left mouse button, drag the line up to the most cranial point of the greater trochanter.
- R** With the right mouse button, go back to the **Module tool**.
- M** Define the position of the point **Free** of your choice.

The connecting line is drawn; the actual body side is defined.

Step 8 Fossa piriformis for anatomical axis **8**

Greater trochanter
- Fossa Piriformis (for aMP...
 - Knee base femur

Requirement: The hip joint center is drawn.
Result: The Fossa Piriformis is indicated by a point.

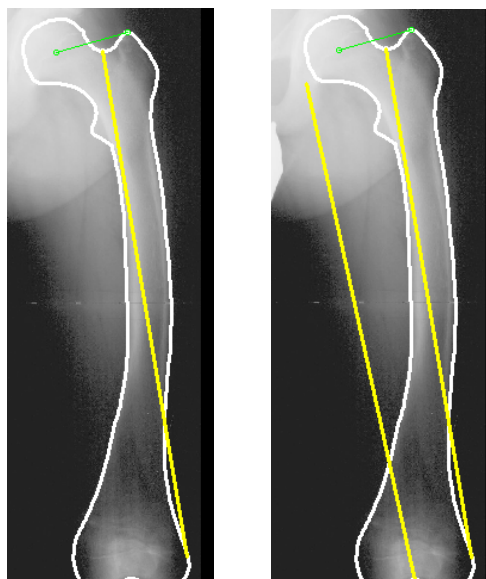
The Fossa Piriformis is necessary as a reference point for the **anatomical** axes.
 Draw the Fossa Piriformis and activate subsequently the function **Axes by Dror Paley**.

- Axes by Dror Paley

Activate the function **Axes by Dror Paley**.

<input checked="" type="checkbox"/>	aMPFA	▶	84.0	▲▼
<input type="checkbox"/>	aLDFA	▶	81.0	▲▼

Activate the function **aMPFA** and, if the knee base center is drawn, the **aLDFA** of the axes tool. Both axes are automatically displayed.
 One starts at the Fossa Piriformis and the other at the knee base center.

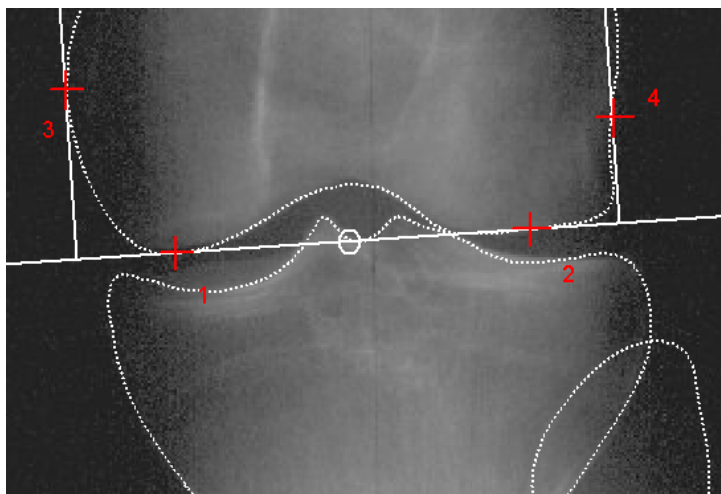


NOTE: All axes can be faded in or out with the function of the **Axes-by Dror Paley Assistant** without being deleted.

Step 9 Define femoral knee base **9**

- Knee base femur
- ~~Knee base tibia~~
- ~~Ankle joint base~~

Requirements: Drawn femoral outline.
Results: The femoral joint base line is positioned and the femoral knee base center is automatically calculated by drawing two perpendicular lines that form a tangent to the lateral and medial femur condyles.



The function **Knee base femur** is activated. After selecting the kind, color, and the size of the line, start drawing the tangential line on the distal condyles. (Refer to the picture above point 1 and 2.)

	L: 1. of 2 base line points R: Exit function M: Free	Knee base femur
--	------------------------------------------------------------	-----------------

- L** ● With the left mouse button, click on the 1st most distal point of the medial /lateral femoral condylus; refer to the picture above point 1.
- R** With the right mouse button, go back to the **Modules tool**.
- M** Define the position of the point **Free** of your choice.

	L: 2. of 2 base line points R: Back M: Free	Knee base femur
--	---------------------------------------------------	-----------------

- L** ● With the left mouse button, click on the 2nd most distal point of the medial /lateral femoral condylus; refer to the picture above point 2.
- R** With the right mouse button, go back to point 1.
- M** Define the position of the point **Free** of your choice.

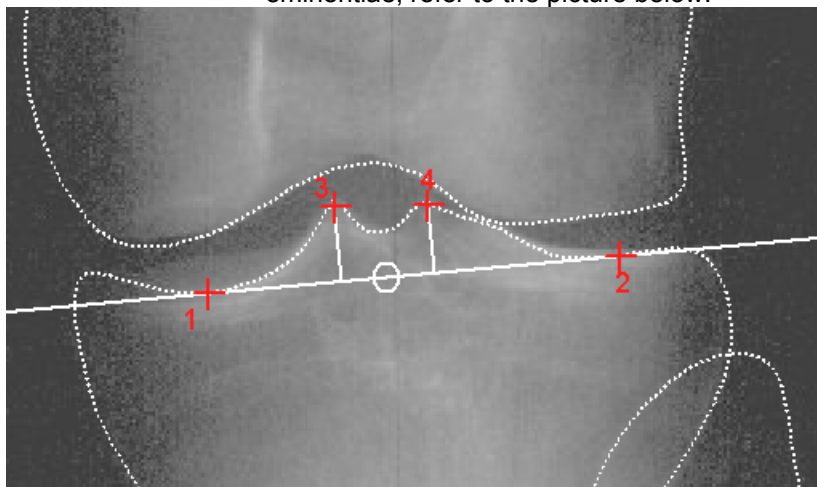
The femoral basic line is displayed. Automatically a perpendicular line appears.

	L: 1. of 2 limits R: Back M: Free	Knee base femur
L ●	Drag the mouse pointer upwards; move perpendicular to a position where it forms a tangent to the lateral femur condylus (3) and click to confirm.	
R	With the right mouse button, go back to the 2nd point of the basic line.	
M	Define the position of the point Free of your choice.	
The knee base center already appears. It changes the position dependent on the movements of the mouse pointer. Finally, define the femoral knee base center in the middle of the distance of the 1 st and the 2 nd perpendicular line.		
	L: 2. of 2 limits R: Back M: Free	Knee base femur
L ●	Drag the mouse pointer upwards; move perpendicular to a position where it forms a tangent to the medial femur condylus (4) and click to confirm.	
R	With the right mouse button, go back to the 1 st lateral tangent.	
M	Define the position of the point Free of your choice.	
The femoral knee base line and the knee base center are displayed.		

Step 10 Define tibial knee base **10**

- Knee base femur
- Knee base tibia**
- Ankle joint base

Requirements: Drawn femoral knee base.
Results: The tibial joint base line is positioned and the tibial knee base center is automatically calculated by drawing two perpendicular lines that form a tangent to the lateral and medial tibia condyles. Alternatively you can use the eminentiae, refer to the picture below.



The function **Knee base tibia** is activated. After selecting the kind, color, and size of the line, start drawing the tangential line on the proximal tibial condyles. Refer to the picture above point 1 and 2.

	L: 1. of 2 base line points	Knee base tibia
	R: Exit function	
	M: Free	

- L** ● With the left mouse button, click on the 1st point of the medial/lateral tibial condylus, refer to the picture above point 1.
- R** With the right mouse button, go back to the **Modules tool**.
- M** Define the position of the point **Free** of your choice.

	L: 2. of 2 base line points	Knee base tibia
	R: Back	
	M: Free	

- L** ● With the left mouse button, click on the 2nd point of the medial/lateral tibial condylus, refer to the picture above point 2.
- R** With the right mouse button, go back to point 1.
- M** Define the position of the point **Free** of your choice.

The tibial base line is displayed. Automatically a perpendicular line appears.

Knee base tibia

L: 1. of 2 limits
R: Back
M: Free

L ● Drag the mouse pointer upwards; move perpendicular to a position where it forms a tangent to the lateral tibial condylus (3) /eminentia and click to confirm.

R With the right mouse button, go back to the 2nd point of the basic line.

M Define the position of the point **Free** of your choice.

The knee base center already appears. It changes the position dependent on the movements of the mouse pointer. Finally you define the tibial knee base center in the center of the distance between the 1st and the 2nd perpendicular line.

Knee base tibia

L: 2. of 2 limits
R: Back
M: Free

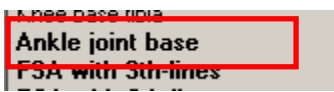
L ● Drag the mouse pointer upwards; move perpendicular to a position where it forms a tangent to the medial tibial condylus (4) /eminentia and click to confirm.

R With the right mouse button, go back to the 1st lateral tangent.

M Define the position of the point **Free** of your choice.

The tibial knee base line and the knee base center are displayed.

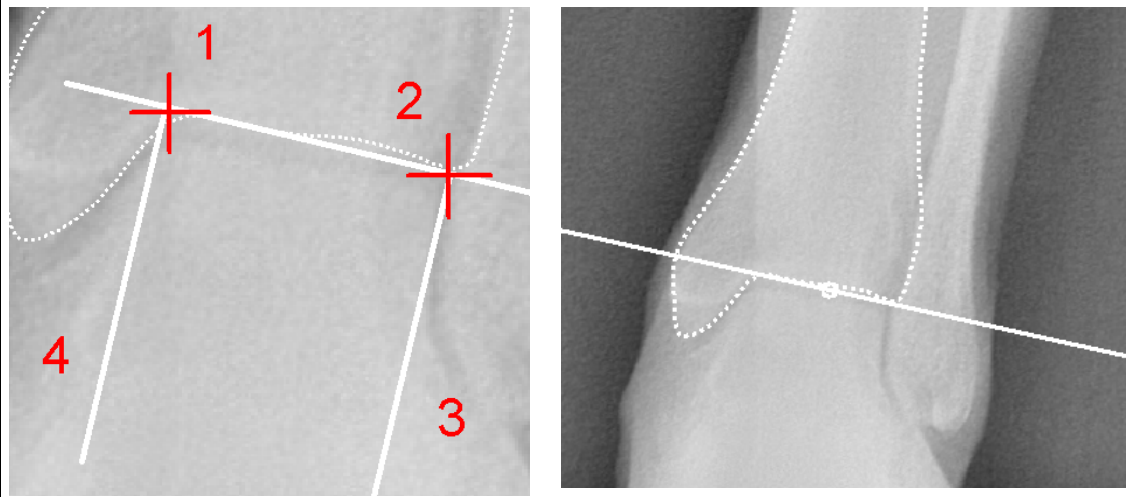
Step 11 Define ankle joint base **11**



Requirements: The hip joint center (HJC), femoral and tibial knee base center are defined.

Results: The ankle joint basic line and the center are displayed.

The function **Ankle joint base** is activated.



You are in the function **Ankle joint base**.
 After selecting the kind, color, and size of the line, start drawing the tangential line from point 1 to point 2.

	L: 1. of 2 base line points R: Exit function M: Free	Ankle joint base
--	------------------------------------------------------------	------------------

- L** ● With the left mouse button, click on the 1st point distal of the distal tibial base, refer to the picture above point 1.
- R** With the right mouse button, go back to the **Modules tool**.
- M** Define the position of the point **Free** of your choice.

	L: 2. of 2 base line points R: Back M: Free	Ankle joint base
--	---------------------------------------------------	------------------

- L** ● With the left mouse button, click on the 2nd point distal tibial base, refer to the picture above point 2.
- R** With the right mouse button, go back the 1st point.
- M** Define the position of the point **Free** of your choice.

The ankle joint basic line is displayed. A perpendicular line appears automatically.

	L: 1. of 2 limits R: Back M: Free	Ankle joint base
--	-----------------------------------------	------------------

- L** ● Drag the mouse pointer upwards; move the perpendicular to a position where it forms a tangent to the talus (point 3) and click to confirm.
- R** With the right mouse button, go back to the 2nd point of the basic line.
- M** Define the position of the point **Free** of your choice.

The ankle joint center already appears. It changes the position dependent on the movements of the mouse pointer. Finally, define the ankle joint center in the center of the distance between the 1st and the 2nd perpendicular line.

	L: 2. of 2 limits R: Back M: Free	Ankle joint base
--	-----------------------------------------	------------------

- L** ● Drag the mouse pointer upwards; move perpendicular to a position where it forms a tangent to the talus (point 4) and click to confirm.
- R** With the right mouse button, go back to the 1st lateral tangent.
- M** Define the position of the point **Free** of your choice.

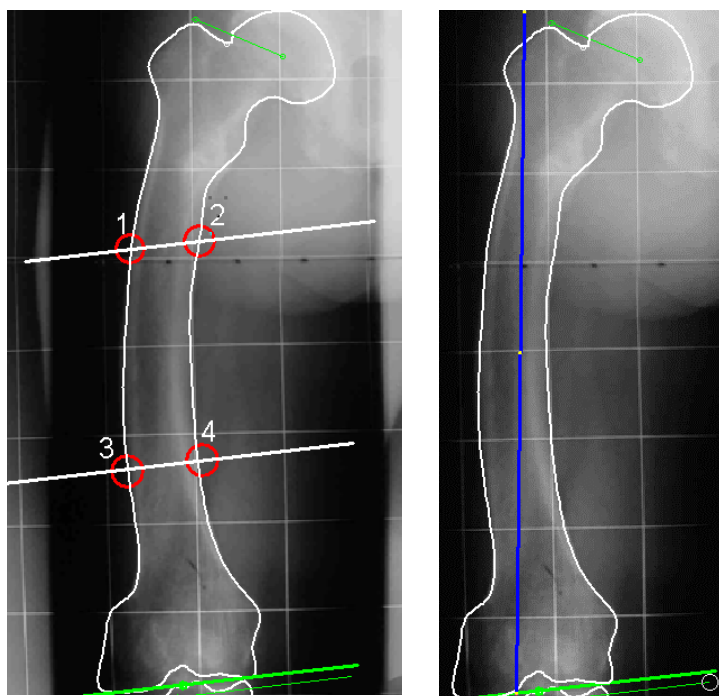
The base line and the ankle joint center are displayed.

- Ankle joint base
- FSA (for AMA)
- Praop. dimensions AP

Requirements: All joint centres are defined as hip-, knee-, and ankle joint.

Result: the anatomical femur axis is displayed automatically in a preview graphic.

Two helping lines are displayed in order to draw the anatomical axes. They are dividing the distance between the hip joint center (HJC) and the femoral knee base center into three equal parts. The axis will be drawn automatically through the middle of the helping lines.



The intersection points of the helping lines and the femur outline have to be touched in pairs (as drawn above 1-4). The anatomical axis as a result appears.

After selecting the kind, color, and size of the line, define the points 1, 2, 3, and 4. The points 1, 2, 3 and 4 are intersection points of the 3rd lines and the bone outline.

You are in the **snap to line**

	L: Define 1. of 4 points	FSA with 3rd-lines
	R: Exit function	
	M: Element or Line	

- L ●** With the left mouse button, click on the 1st point (1).
- R** With the right mouse button, exit the function.
- M** Element or line is preinstalled as snap to function.

	L: Define 2. of 4 points	FSA with 3rd-lines
	R: Back	
	M: Element or Line	

- L ●** With the left mouse button, click on the 2nd point (2).
- R** With the right mouse button, exit the function.
- M** Element or line is preinstalled as snap to function.

	L: Define 3. of 4 points	FSA with 3rd-lines
	R: Back	
	M: Element or Line	

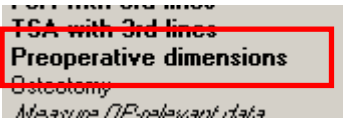
- L ●** With the left mouse button, click on the 3rd point (3).
- R** With the right mouse button, exit the function.
- M** Element or line is preinstalled as snap to function.

	L: Define 4. of 4 points	FSA with 3rd-lines
	R: Back	
	M: Element or Line	

- L ●** With the left mouse button, click on the 4th point (4).
- R** With the right mouse button, exit the function.
- M** Element or line is preinstalled as snap to function.

The anatomical axis is drawn automatically.

Please repeat this procedure in the same way for the tibial anatomical axis.



Requirements: All joint centres and both anatomical axes are shown.

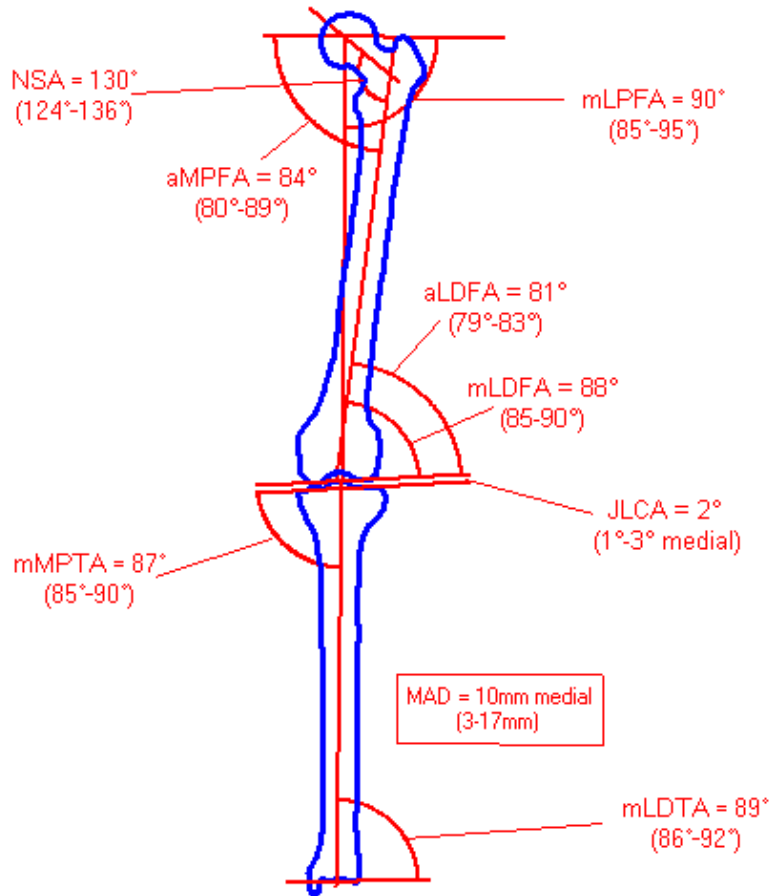
Result: The preoperative mechanical axes and the center line are automatically inserted and are shown as a preview together with all relevant values.

Scheme and abbreviations:

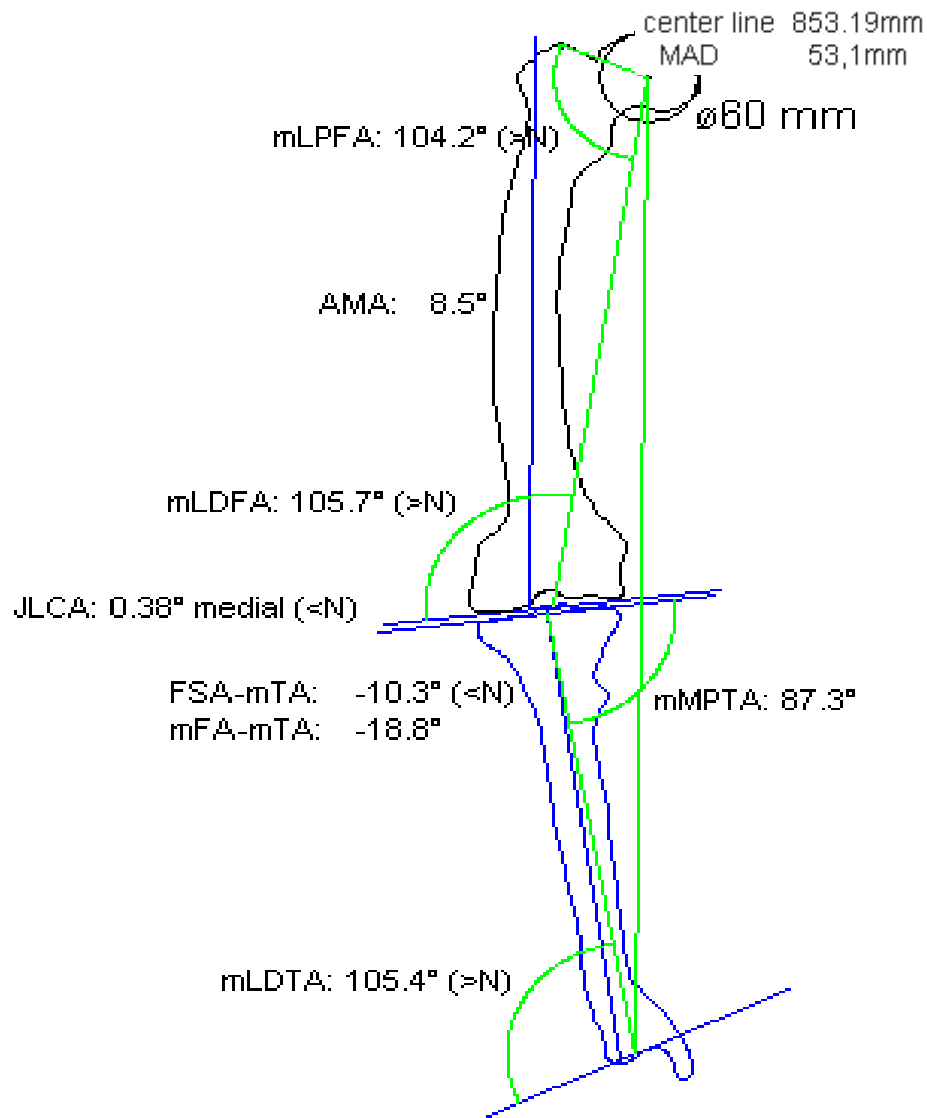
m= mechanical	a= anatomical
D= distal	P= proximal
F= femur	T= tibia
A= angle	L=Lateral

ACA	Angle of Correction of Angulation
aLDFA	anatomical Lateral Distal Femoral Axis
AMA	Anatomical Mechanical Angle (angle between anatomical and mechanical axis)
aMLFA	anatomical Medial Lateral Femur Axis
aMPFA	anatomical Medial Proximal Femur Axis
Center Line	Mikulicz
CORA	Center of Rotation of Angulation (Center of Deformity) is created by the moving the NCORA.
NCORA	neutral CORA, is always the original center of deformity
FSA-mTA	Femur Shaft Axis (anatomical)–mechanical Tibia Axis
HJC	Hip Joint Center
JLCA	Joint Line Conversion Angle (angle between KJL-F and KJL-T)
KJL-F	Knee Joint Line–Femur (proximal knee base)
KJL-T	Knee Joint Line–Tibia (distal knee base)
lbl	Longitudinal Bisector Line
MAD	Mechanical Axis Deviation
mFA-mTA	mechanical Femur Axis–mechanical Tibia Axis
Mikulicz	Center line (Mikulicz=german)
mLDFA	mechanical Lateral Distal Femoral Axis
mLDTA	mechanical Lateral Distal Tibial Axis
mLPFA	mechanical Lateral Proximal Femoral Axis
mMPTA	mechanical Medial Proximal Tibial Axis
NSA	Neck Shaft Angle (= CCD-angle)
RDA	Real Deformity Angle (Real angle of the maldisposition)
TSA	Tibia Shaft Axis
tbl	Transversal Bisector Line

The nomenclature of all values as Dror Paley Standard Measurements
Description of the normal values:



Actual preoperative dimensions:



Activate the function **Preoperative dimensions** and the preview with all relevant dimensions is attached to the mouse pointer.

	L: Destination point	Measure femure AP
	R: Exit function	
	M: Free	

- L** ● With the left mouse button, place the graphic to the requested position.
- R** With the right mouse button, go back to the **Osteotomy tool**.
- M** Define the position of the point **Free** of your choice.

The preoperative dimensions belong to your planning and are important for further judgements and documentation.



Note Position the objects on the **left** next to the x-ray. This leaves enough space for the previews of the postoperative joint situation on the **right** side next to the x-ray.

Step 14 Define Axes as „Dror Paley“ **14**

- Präop. dimensions AP
- Axes by Dror Paley

Requirements: All joint centers have to be drawn.
Result: The preoperative mechanical axes and the center line are shown and all *normal* angles in degree are calculated.
 With the pull-down arrows you can change the values. The min/normal/max values remain visible for your orientation. If afterwards you choose one of the min/normal/max values, the original situation will be recovered.

Achsen nach Dror Paley

<input checked="" type="checkbox"/> mLPFA	▶	90.0	◀▶
<input type="checkbox"/> AMA	▶	7.0	◀▶
<input checked="" type="checkbox"/> mL DFA	▶	88.0	◀▶
<input type="checkbox"/> aMPFA	▶	84.0	◀▶
<input type="checkbox"/> aLDFA	▶	81.0	◀▶
<input checked="" type="checkbox"/> mMPTA	▶	87.0	◀▶
<input checked="" type="checkbox"/> mLDTA	▶	89.0	◀▶
<input type="checkbox"/> aPDFA	▶	0.0	◀▶
<input type="checkbox"/> aPPTA	▶	0.0	◀▶
<input type="checkbox"/> aPPTA	▶	0.0	◀▶

Hilfsachse - 4Pkt

Hilfsachse - 2Pkt

min: 85.0°
 norm: 90.0°
 max: 95.0°

Description of the Axes Assistant.

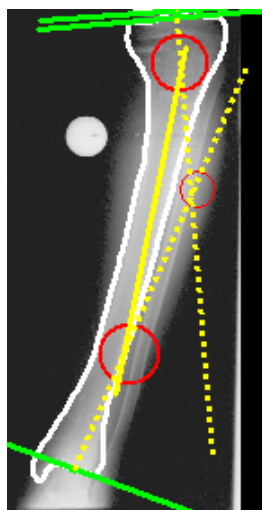
<input checked="" type="checkbox"/> mLPFA	▶	90.0	▲▼
<input type="checkbox"/> AMA	▶	7.0	▲▼
<input checked="" type="checkbox"/> mLDFA	▶	88.0	▲▼

<input checked="" type="checkbox"/> mLPFA	▶	91.0	▲▼
<input type="checkbox"/> AMA	▶	7.0	▲▼

<input checked="" type="checkbox"/> mLPFA	▶	96.0	▲▼
<input type="checkbox"/> AMA	▶	7.0	▲▼

<input type="checkbox"/> aPDFA	▶	0.0	▲▼
<input type="checkbox"/> aPPTA	▶	0.0	▲▼
<input type="checkbox"/> aPPTA	▶	0.0	▲▼

Auxiliary axis - 4Pnt	
Auxiliary axis - 2Pnt	



The **normal value** is indicated green and is the mean value between the minimum and the maximum.

min: 85.0°
norm: 90.0°
max: 95.0°

A **black** value is a value within min and max.

A **red** value is beyond min. and max.

This value apply to the calculation in a sagittal view.

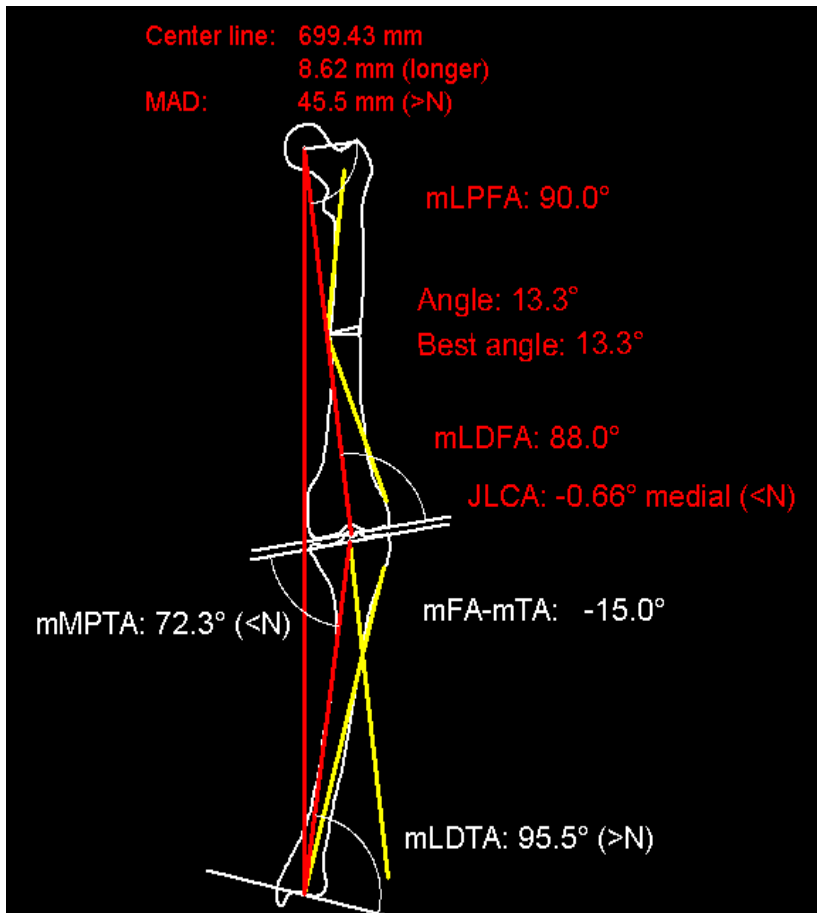
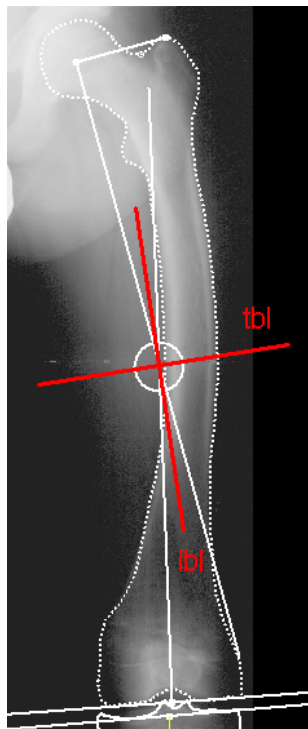
With **Auxiliary axis – 4 points** you can construct a line between 4 points, refer to the description on **STEP 12**.

With **Auxiliary axis – 2 points** you can construct a line. The starting point and the end mark a new CORA, even if it is beyond the outline of the bone. With this line you can define the center of deformity at different positions. The osteotomy angles can be adjusted.

- EXERCISE 15.101.1 -
- OSTEOTOMY

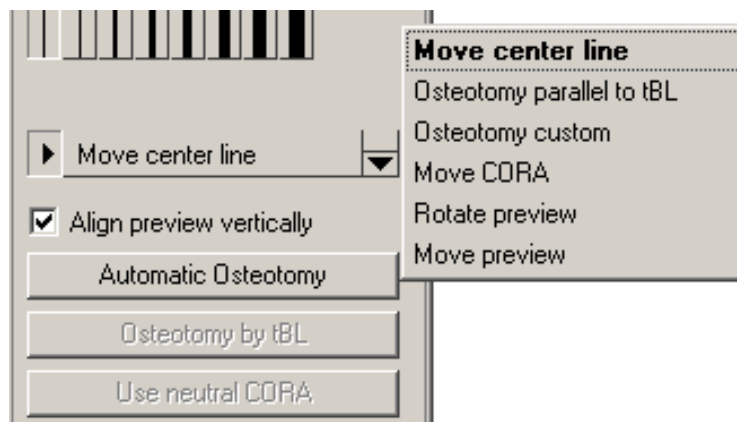
Requirements: All joint centers and both mechanical axes have to be drawn. One or multiple CORAs (centres of deformity) have to be defined.

Results: With reference to the defined basic elements (see requirements) and the definition of tbl and lbl the first simulated result is shown in a preview. The mechanical axes, the angles and all other values are calculated automatically.



Procedure:

1. You activate the function **OSTEOTOMY**.
2. At the intersection of the mechanical axes (NCORA) crosshairs will appear.
Caution: If there exist more than one intersections, take care that you define the right intersection where to make the first osteotomy.
3. Confirm tbl and lbl.
4. A preview is build, in which at first the optimal angle of correction is applied.
5. Afterwards, make the desired corrections considering all possible options.
You choose the options with the **Osteotomy Assistentt**.

**NOTE:**

The following steps explain the possible options of a planning in this order:

- 14a** Osteotomie with an automatically calculated angle
- 14b** Move center line
- 14c** Osteotomy parallel to tbl
- 14d** Osteotomy custom
- 14e** Move CORA
- 14f** Rotate preview
- 14g** Move preview

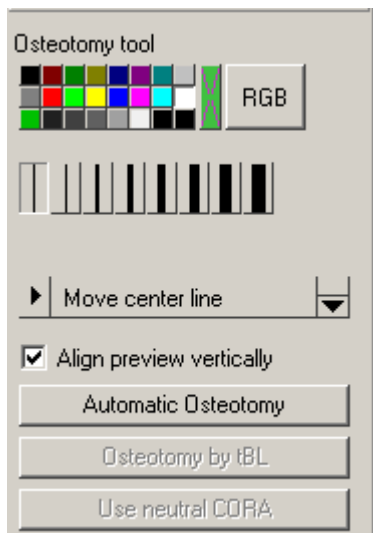
(The previews are sometimes overdrawn in order to show precisely the principle of the procedure.)

WARNING:

After you have applied your preview the calculated angle of correction also appears on the original image. If you want to go on you may:

1. Keep this angle in order to include it in the following calculations and osteotomies.
2. Not keep this angle to make a complete new calculation, but you want to keep the old preview on the screen. In this case the angle shown **on the original image** has to be deleted completely.

The Osteotomy Assistant



Select the required color:



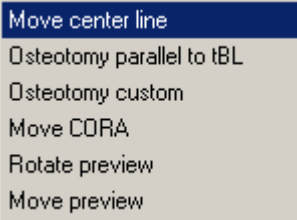
1. By the palette.



2. Select the inverse color (as photo negative).

RGB

3. Free choice of RGB colors.



Menu for manual changes.
All options can be applied individual or in combination.

Align preview vertically is activated automatically. The preview is shown always vertically. If you rotated the preview with the function **Rotate preview** you can go back to the vertical view.

Automatic Osteotomy can be activated as soon as a manual changing with one of the options should be cancelled. The automatically calculated Osteotomy will be repeated and displayed again.

Osteotomy by tbl can be activated as soon as you want to cancel a calculation with the function **Osteotomy parallel to tbl**. The calculation with respect of the automatic tbl will be repeated and displayed again.

Use neutral CORA can be activated as soon as you want to cancel a calculation done with the function **Move CORA**. The calculation with respect of the automatically calculated CORA will be repeated and displayed again.

Step 15a Osteotomy with an angel automatically calculated

15a

Activate the function **OSTEOTOMY** of the **Modules Assistant**.



L:
R: Exit function
M: Axes

Osteotomy tool
Angle: 13.3° varus

- L •** Move the mouse near to the desired CORA until tbl and lbl appear. With the left mouse button, confirm tbl and lbl of the CORA.
WARNING: Take care to choose the desired CORA if more than one are shown.
- R** With the right mouse button, exit the function and start again.
- M** The snap to mode for **Axes** is preinstalled.

The calculated angle of deformity is already shown.

The first preview including all relevant and automatically calculated values is attached to the mouse. The calculation by the Orthopaedic Application is done in order to get the axes situation in within the limits as Dror Paley.



L: Destination point
R: Exit function
M: Free

Osteotomy tool

- L •** With the left mouse button, position the preview on the screen.
- R** With the right mouse button, exit the function and start again.
- M** The mode **Free** is preinstalled.

The result shows the automatically proposed angle of correction of the Orthopaedic Application.



L: Grab point
R: Accept/Reject planning
M: Free

Osteotomy tool

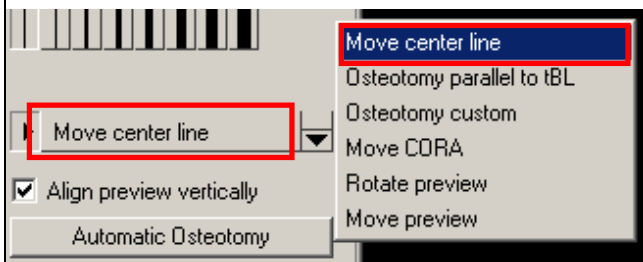
- L** **Not relevant**
- R •** With the right mouse button, open the window for **Apply, Reject** and **Back**. Choose **Apply**.
- M** Define the position of the point **Free** if your choice.

The automatic calculation is shown.

The preview is no longer changeable.

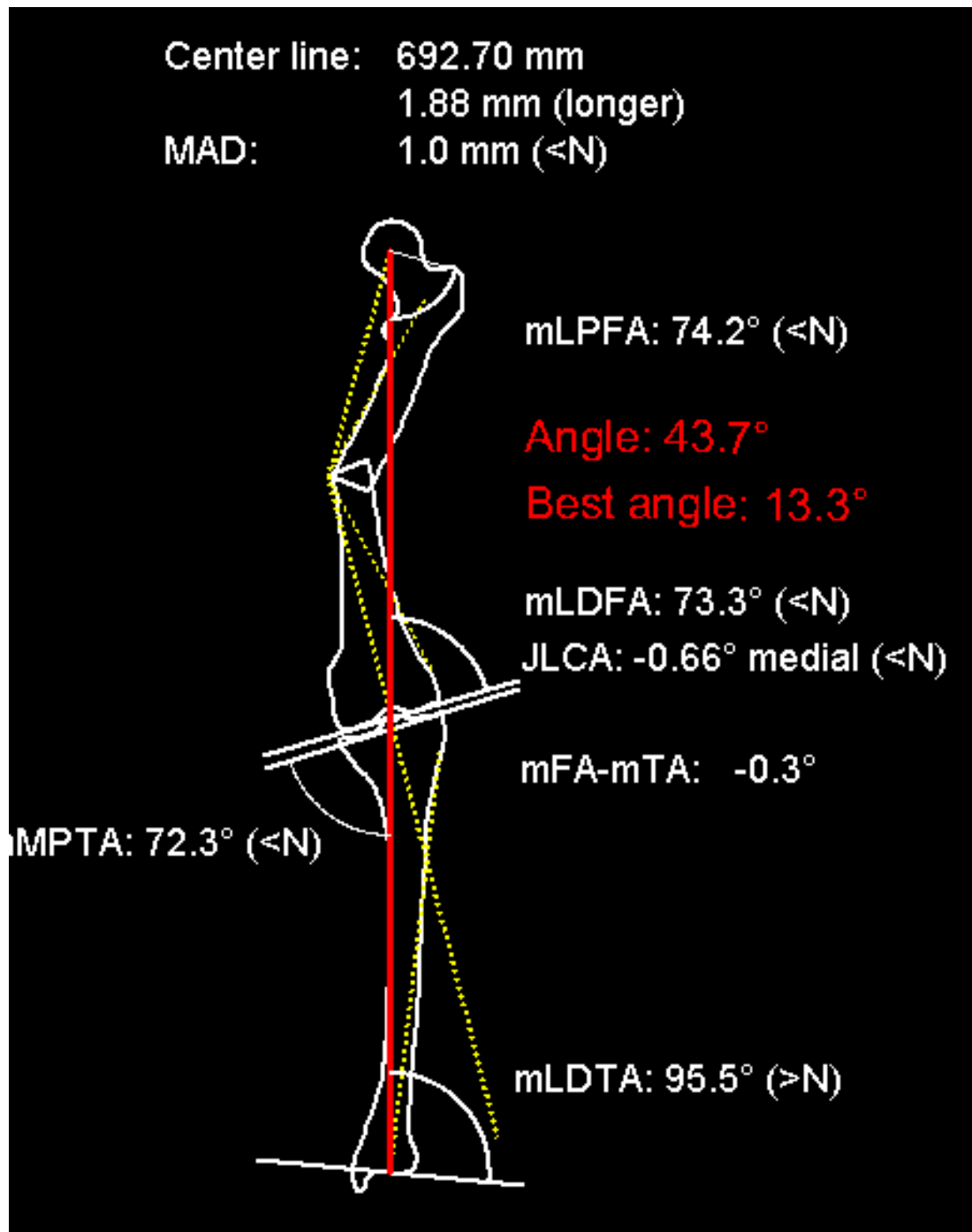
For the preview, refer to step **14** Osteotomy Basics.

Step 15b Osteotomie and move center line, keep CORA **15b**



Requirements: The preview including the automatically calculated angles is placed preliminary.

Result: You define size and kind of the angel of correction without changing the CORA (center of rotation). All relevant measurements are calculated referring to the actual changesments.



You activate **Osteotomy** with the **Module Assistant**.



L:
R: Exit function
M: Axes

Osteotomy tool
Angle: 13.3° varus

- L •** Move the mouse near to the desired CORA until tbl and lbl appear. With the left mouse button, confirm tbl and lbl of the CORA.
WARNING: Take care to choose the desired CORA if more than one are shown.

R With the right mouse button, exit the function and start again.

M The snap to mode for axes is preinstalled.



L: Destination point
R: Exit function
M: Free

Osteotomy tool

- L •** With the left mouse button, place the first calculated preview to the desired position.

With the **Osteotomy Assistant**



L: Grab point
R: Accept/Reject planning
M: Free

Osteotomy tool

- L •** With the left mouse button, choose a position near to the femur.

1. The mouse cursor is automatically attached to the CORA.
2. While you move the mouse the position of the center line and the proximal segment of the femoral outline change.
3. All measurements are changing simultaneously.
4. The new angle of correction will be inserted to the original image.



L: Destination point
R: Back
M: Free

Osteotomy tool

- L •** With the left mouse button, confirm your desired result.

The result shows the desired changes.



L: Grab point
R: Accept/Reject planning
M: Free

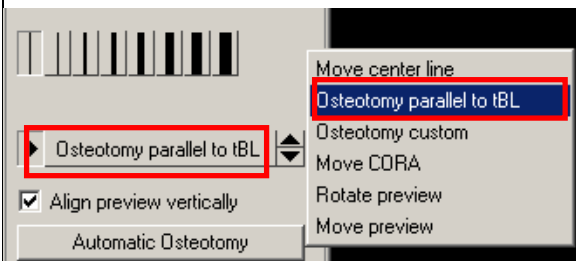
Osteotomy tool

- L** With the left mouse button, repeat the procedure again (or change to another option of the Osteotomy Assistant e.g. **Osteotomy parallel to tbl**). With the left mouse button, activate the function **Destination point** again and change the position of the center line until the desired result is achieved.
- R •** With the right mouse button, open the window for Apply, Reject and Back. Choose **Apply**.
- M** Define the position of the mouse pointer **Free** if your choice.

The calculation is shown.

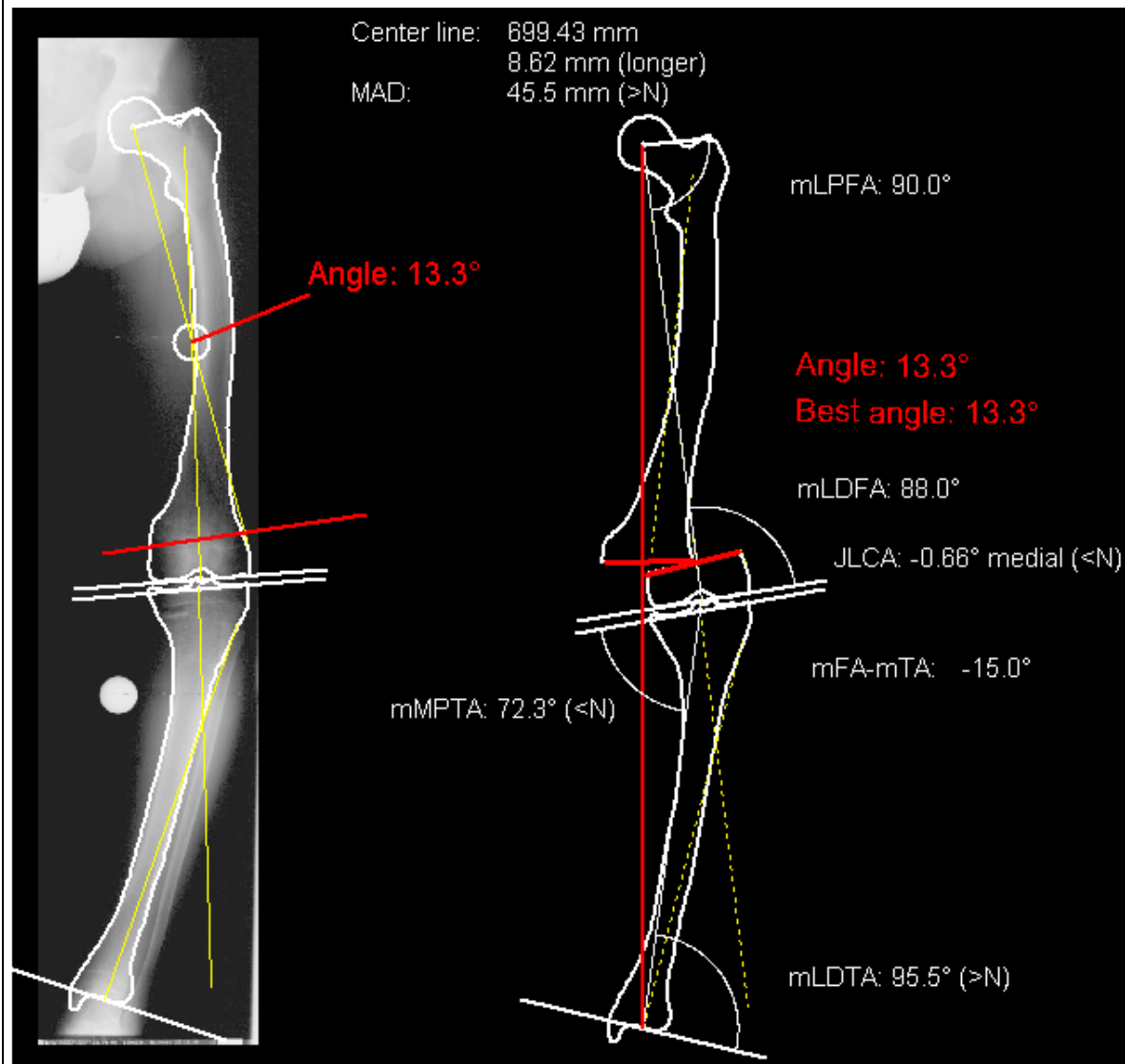
It is now no longer possible to move or change the preview.

Step 15c Osteotomie parallel to tBL, keep CORA



Requirements: The preview is temporary positioned. Automatically calculated angle of correction is shown.

Result: You define a parallel position of the tBL without changing the position of the CORA. The size of the angel of correction keeps constant. All relevant measurements are calculated refering to the actual changements.



You activate **Osteotomy** with the **Module Assistant**



L:
R: Exit function
M: Axes

Osteotomy tool
Angle: 13.3° varus

L • Move the mouse near to the desired CORA until tbl and lbl appear. With the left mouse button, confirm tbl and lbl of the CORA.
WARNING: Take care to choose the desired CORA if more than one are shown.

R With the right mouse button, exit the function and start again.

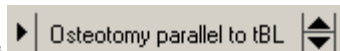
M The snap to mode for axes is preinstalled.



L: Destination point
R: Exit function
M: Free

Osteotomy tool

L • With the left mouse button, place the first calculated preview to the desired position.



With the **Osteotomy Assistant**



L: Start moving osteotomy line
R: Accept/Reject planning
M: Free

Osteotomy tool

Attention: Osteotomy on the original and NOT on a preview!

L • With the left mouse button, click on a position of your choice to confirm a parallel line of the tbl. This parallel line is attached to the mouse pointer.

L • Place the new tbl to the desired position.

NOTE: choose the new position on the original image, not on the preview!

1. While moving the parallel tbl, the osteotomy changes its position in the preview.
2. At the same time, all relevant measurements are changing.
3. The angle of correction is inserted to the original image.

If you click the left mouse button again the function **Osteotomy parallel to tbl** is active again and you can change the position of the tbl until you achieve the desired result.

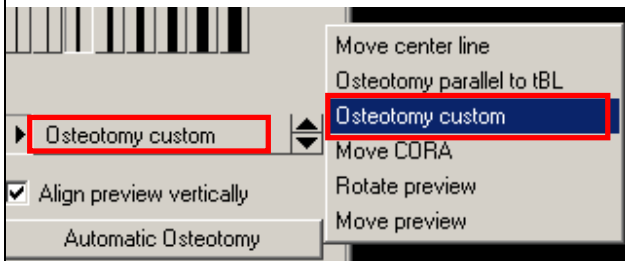
R • With the right mouse button, open the window for Apply, Reject and Back. Choose **Apply**.

M Define the position of the mouse pointer **Free** if your choice.

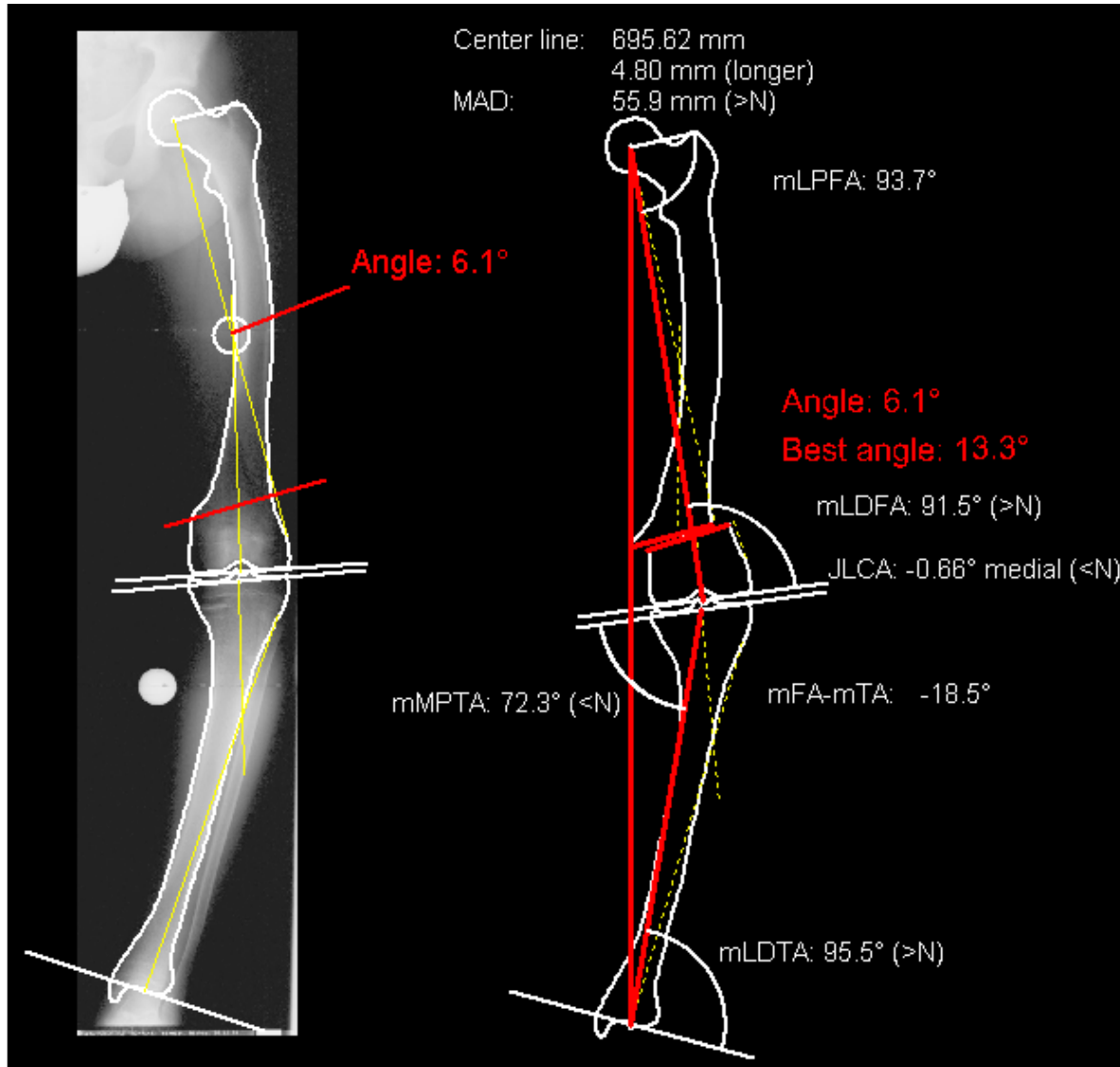
The new preview is displayed.

The preview is not changeable any more.

Step 15d Osteotomy custom, keep CORA **15d**



Requirements: The preview is temporary positioned. The automatically calculated angel of correction is shown.
Result: You define a resection line of your own choice without changing the position of the CORA. The size of the angel of correction changes referring to the inclination of your line.
 All relevant measurements are calculated referring to the actual changesments.



You activate **Osteotomy** with the **Module Assistant**.



L:
R: Exit function
M: Axes

Osteotomy tool
Angle: 13.3° varus

L • Move the mouse pointer near to the desired CORA until tbl and lbl appear. With the left mouse button, confirm tbl and lbl of the CORA.

WARNING: Take care to choose the desired CORA if more than one are shown.

R With the right mouse button, exit the function and start again.

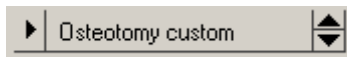
M The snap to mode for axes is preinstalled.



L: Destination point
R: Exit function
M: Free

Osteotomy tool

L • With the left mouse button, place the first calculated preview to the desired position.



With the **Osteotomy Assistant** choose



L: 1. of 2 points of intersection line
R: Accept/Reject planning
M: Free

Osteotomy tool
Attention: Osteotomy on the original and NOT on a preview!

L • With the left mouse button, define the start position with a resection line of your choice.

NOTE: choose the new position on the original image, not on the preview!



L: 2. of 2 points of intersection line
R: Back
M: Free

Osteotomy tool
Attention: Osteotomy on the original and NOT on a preview!

L • With the left mouse button, define the end position of your resection line and so the inclination of the resection line.

R With the right mouse button, go back to the starting point of the resection line.

M Define the position of the mouse pointer **Free** if your choice.

1. The osteotomy is variable by length and direction referring to the movement of the mouse.
2. While moving the mouse, the angle of correction simultaneously changes kind and size.
3. At the same time all relevant measurements are changing.
4. The angle of correction is inserted to the original image.

If you press the left mouse button again the function **Osteotomy custom** is again active and you can draw your resection line until you achieve the desired result.



L: 1. of 2 points of intersection line
R: Accept/Reject planning
M: Free

Osteotomy tool
Attention: Osteotomy on the original and NOT on a preview!

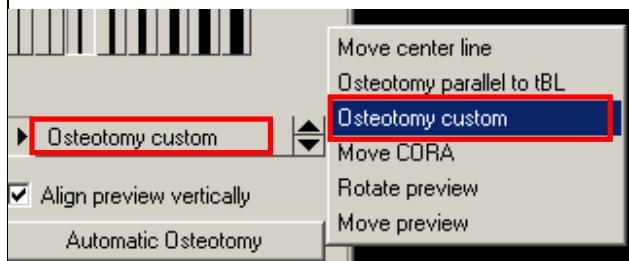
R • With the right mouse button, open the window for Apply, Reject and Back. Choose **Apply**.

M Define the position of the mouse pointer **Free** if your choice.

The new preview is displayed.

The preview is not changeable any more.

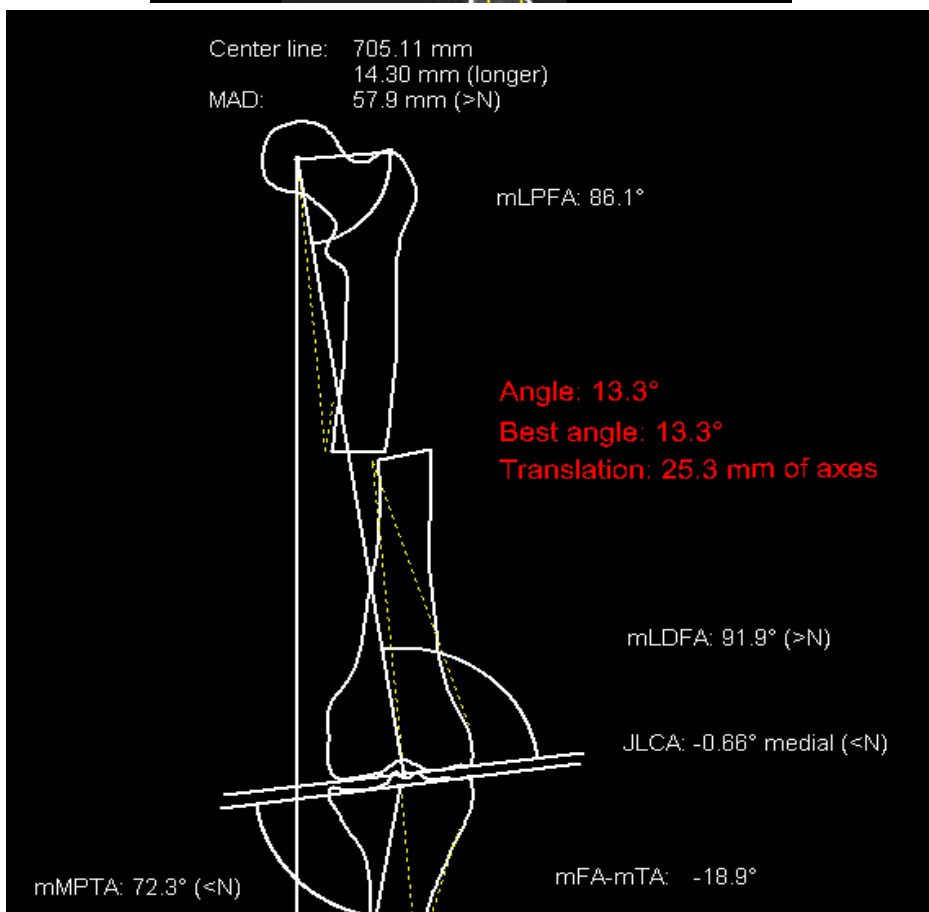
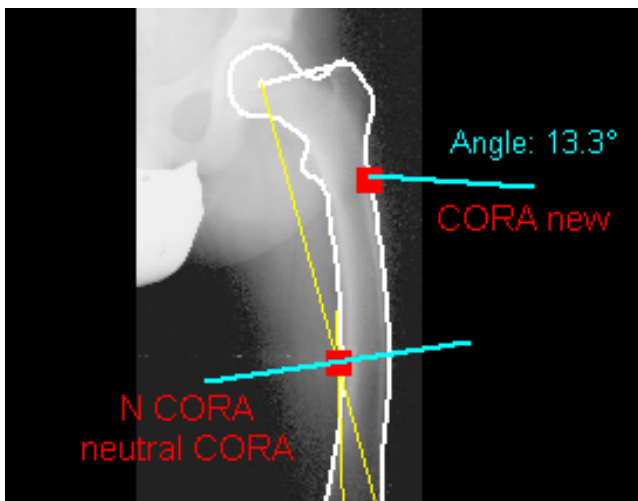
Step 15e Osteotomy by moving CORA **15e**



Requirements: The preview is temporarily positioned. The automatically calculated angle of correction is shown.

Result: The size of the automatically calculated angle will be kept. The CORA is on a new, desired position. The Osteotomy is on the tBL.

NOTE: To move the CORA out of the center of deformation may cause a translation. The size of the translation is automatically calculated and displayed.



You activate **Osteotomy** with the **Module Assistant**



L:
R: Exit function
M: Axes

Osteotomy tool
Angle: 13.3° varus

L • Move the mouse pointer near to the desired CORA until tbl and lbl appear. With the left mouse button, confirm tbl and lbl of the CORA.

WARNING: Take care to choose the desired CORA if more than one are shown.

R With the right mouse button, exit the function and start again.

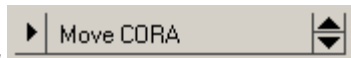
M The snap to mode for axes is preinstalled.



L: Destination point
R: Exit function
M: Free

Osteotomy tool

L • With the left mouse button, place the first calculated preview to the desired position.



With the **Osteotomy Assistant**



L: Start moving rotation center
R: Accept/Reject planning
M: Free

Osteotomy tool
Attention: Osteotomy on the original and NOT on a preview!

L • With the left mouse button, confirm the NCORA. Attached to the mouse pointer you have a line. Drag the line to the desired new position **on the original image, not on the preview!** While moving the CORA the preview shows the preliminary result and the translation changes its value.



L: Zielpunkt
R: Zurück
M: Frei

Osteotomie Assistent
Achtung: Osteotomieren Sie am Original

L • With the left mouse button, confirm the new position of the CORA **on the original image, not on the preview!** The angle keeps its calculated size, and the translation is shown.

L • With the left mouse button, repeat this procedure.

R • With the right mouse button, open the window for Apply, Reject and Back. Choose **Apply**.

M Define the position of the mouse pointer **Free** of your choice.

The new CORA is positioned. The resection is done on the tbl with the calculated angle.

All steps described under 15a to 15e

- Osteotomie with an angle automatically calculated
- Move center line
- Osteotomy parallel to tbl
- Osteotomy custom
- Move CORA

It is possible to combined functions with other function when **Osteotomy** is active.


As soon as you have finished with **Apply** or **Back**, you have to start the function **Osteotomy** again.

1. Move CORA and osteotomy parallel to tBL

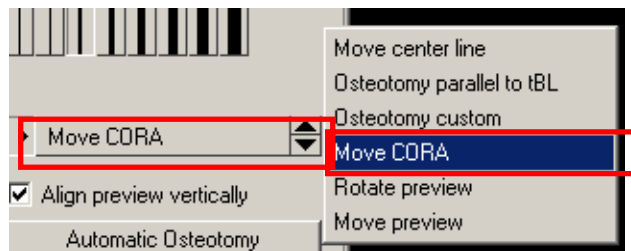
You activate **Osteotomy** with the **Module Assistant**.

	L: R: Exit function M: Axes	Osteotomy tool Angle: 13.3° varus
-----------------------------------------------------------------------------------	-----------------------------------	--------------------------------------

- L •** Move the mouse pointer to the desired CORA until tBL and lBl appear
 With the left mouse button, confirm tBL and lBl of the CORA.

	L: Destination point R: Exit function M: Free	Osteotomy tool
-----------------------------------------------------------------------------------	-----------------------------------------------------	----------------


- L •** With the left mouse button, place the first calculated preview to the desired position.



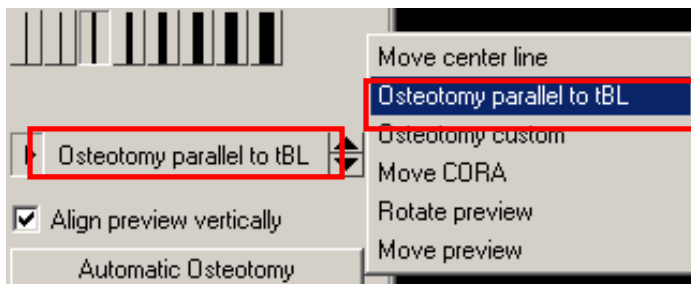
With the **Osteotomy Assistant** chose

	L: Start moving rotation center R: Accept/Reject planning M: Free	Osteotomy tool Attention: Osteotomy on the original and NOT on a preview!
-----------------------------------------------------------------------------------	-------------------------------------------------------------------------	------------------------------------------------------------------------------




- L •** With the left mouse button, confirm the CORA. Attached to the mouse pointer is a line. Drag the line to the desired new position **on the original image, not on the preview!**
 While moving the CORA, the preview shows the preliminary result and the translation changes its value.

	L: Destination point R: Back M: Free	Osteotomy tool Attention: Osteotomy on the original and NOT on a preview!
-------------------------------------------------------------------------------------	--------------------------------------------	------------------------------------------------------------------------------

- L •** With the left mouse button, confirm the new position of the CORA **on the original image, not on the preview!**
 The angel so far keeps its calculated size, the translation is shown and the preview is positioned on the screen.

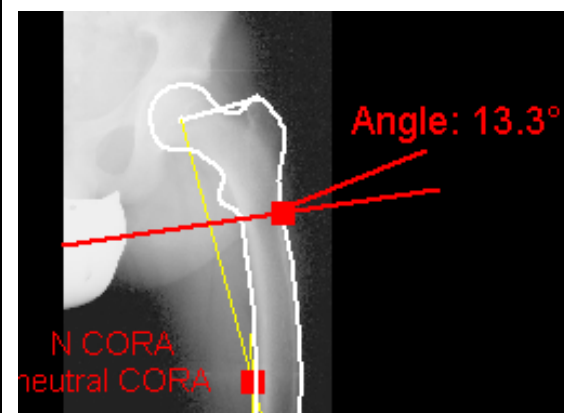
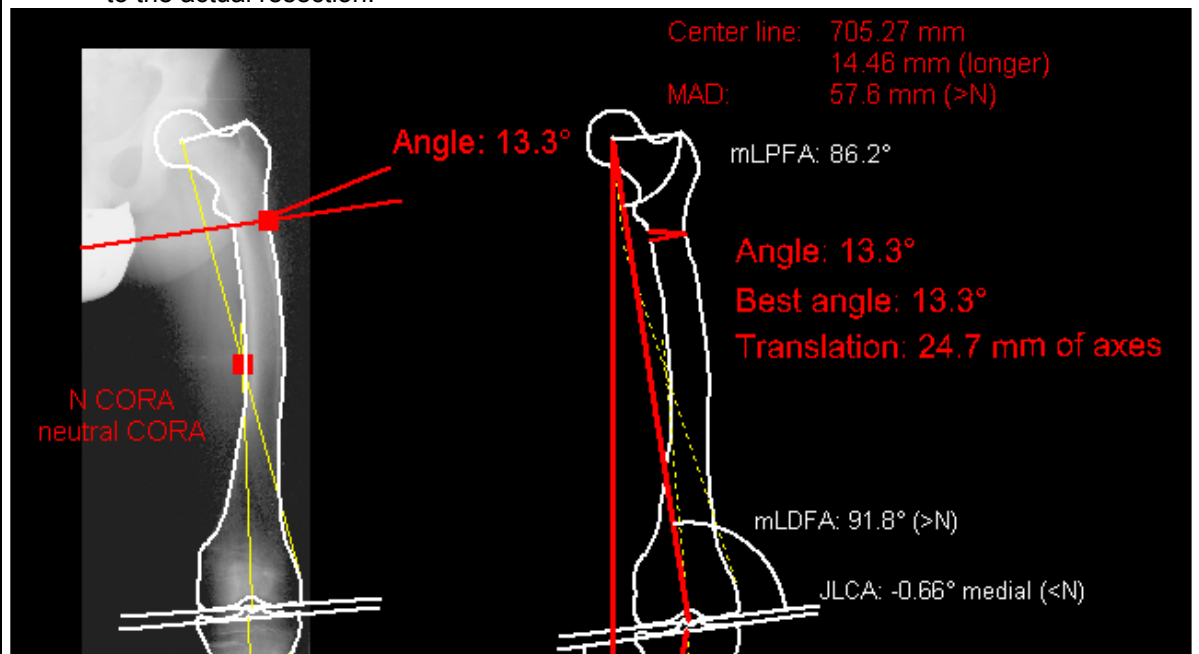


With the **Osteotomy Assistant** choose

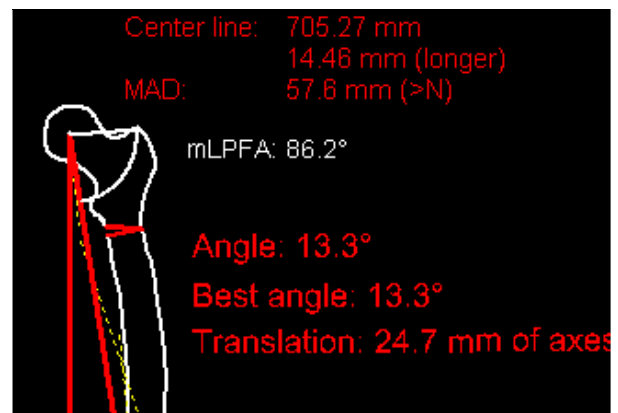
 <p>L: Start moving osteotomy line R: Accept/Reject planning M: Free</p>	<p>Osteotomy tool Attention: Osteotomy on the original and NOT on a preview!</p>
<p>L ● With the left mouse button, confirm the parallel line to tbl. It will be attached to the mouse pointer.</p>	
 <p>L: Destination point R: Back M: Free</p>	<p>Osteotomy tool Attention: Osteotomy on the original and NOT on a preview!</p>
<p>L ● With the left mouse button, place the new tbl to the desired position on the original image, not on the preview!</p>	
 <p>L: Start moving osteotomy line R: Accept/Reject planning M: Free</p>	<p>Osteotomy tool Attention: Osteotomy on the original and NOT on a preview!</p>
<p>L ● With the left mouse button, repeat this function again. R ● With the right mouse button, open the window for Apply, Reject and Back. Choose Apply.</p>	

The new preview shows:

- Open wedge
- With a new rotation center (CORA)
- A resection line running through the new CORA
- All measurements and all values like center line, MAD, and Translation refer automatically to the actual resection.



Detail of the original image



Detail of the preview

2. Double osteotomy metaphyseal and intertrochanteric

Step 1: To draw an auxiliary line, first show the axes with the function

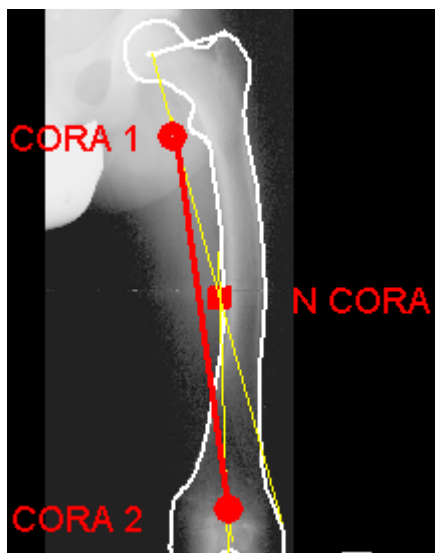
Axes by Dror Paley.

- Axes by Dror Paley
- OSTEOTOMY

Step 2: With the Tool Assistant **Axes by Dror Paley**, choose

Auxiliary axis - 2Pnt

and draw the auxiliary line. The intersection points of the line with the **mLPFA** and the **mLDFA** define **CORA1** and **CORA2**.



Step 3: You activate with **Module Assistant** the function **Osteotomy**.



L:
R: Exit function
M: Axes

Osteotomy tool
Angle: 21.2° varus

L • Move the mouse pointer to **CORA1** on the **on the original image, not on the preview!** Confirm tbl and lbl with the left mouse button.

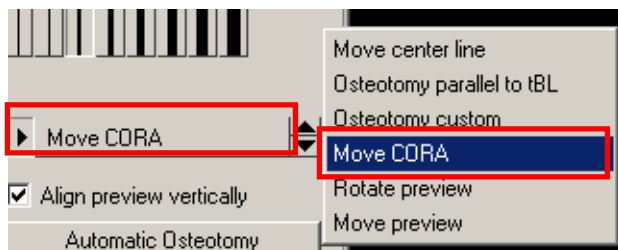


L: Destination point
R: Exit function
M: Free

Osteotomy tool

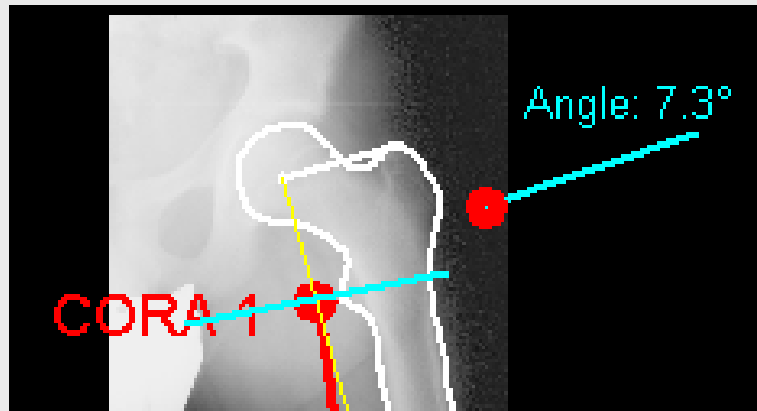
L • With the left mouse button, place the preview to a desired position on the screen.


Step 4: With the **Osteotomy Assistant** choose:



 <p>L: Start moving rotation center R: Accept/Reject planning M: Free</p>	<p>Osteotomy tool Attention: Osteotomy on the original and NOT on a preview!</p>
--------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------

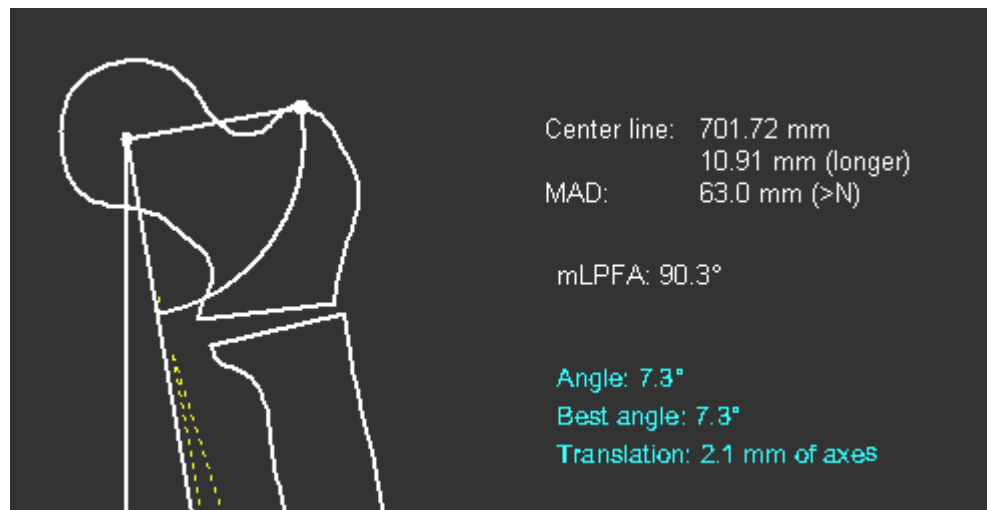
- L** • With the left mouse button, confirm the function. Attached to the mouse pointer the line appears. Drag the mouse pointer to the desired position on the **original image**.
- L** • With the left mouse button, define the new position of the **CORA 1**.
NOTE: by choosing the new position of the CORA1 subsequently the kind of the angle and a possible translation will be defined:
Open wedge means the CORA is near to the medial corticalis
Closed wedge means the CORA is near to the lateral corticalis
With translation means the CORA does not touch the tbl
Without translation means the CORA is on the tbl



 <p>L: Start moving rotation center R: Accept/Reject planning M: Free</p>	<p>Osteotomy tool Attention: Osteotomy on the original and NOT on a preview!</p>
----------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------

- L** • With the left mouse button, repeat the procedure.
- R** • with the right mouse button you open the window for Apply, Reject and Back. Choose **Apply**.


The first Osteotomy is displayed. All values are calculated.



Step 5: With the **Osteotomy Assistant** you choose **Osteotomy**.

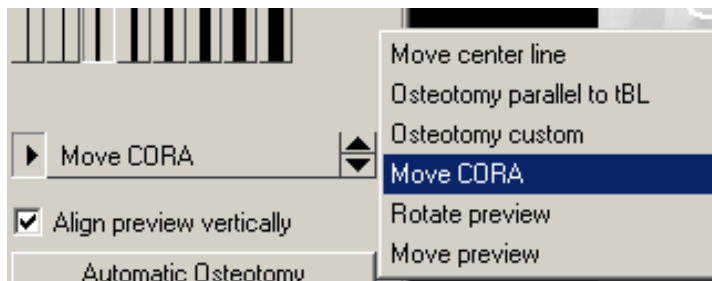

 L: Osteotomy tool
 R: Exit function
 M: Axes
 Angle: 21.2° varus

L • Move the mouse pointer to **CORA2** on the **on the original image, not on the preview!** Confirm tbl and lbl with the left mouse button.


 L: Destination point
 R: Exit function
 M: Free
 Osteotomy tool

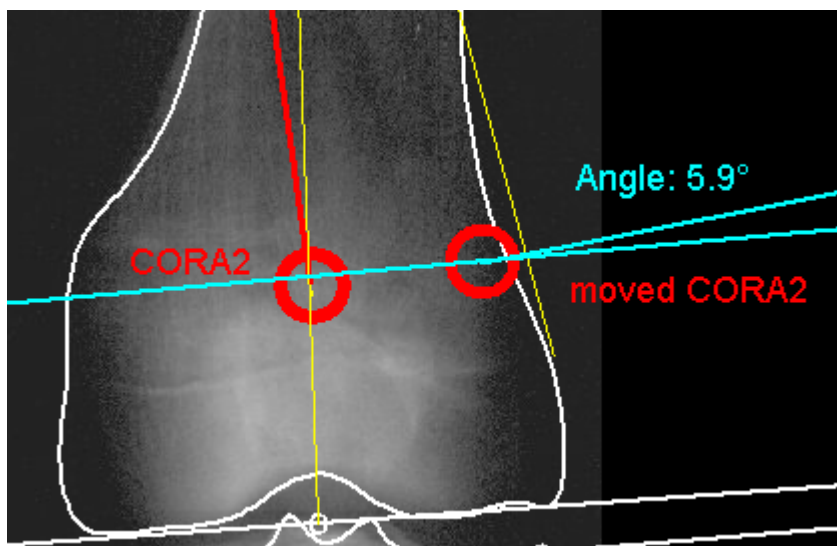
L • With the left mouse button, place the preview to a desired position on the screen.

Step 6: With the **Osteotomy Assistant** you choose **Move CORA**.



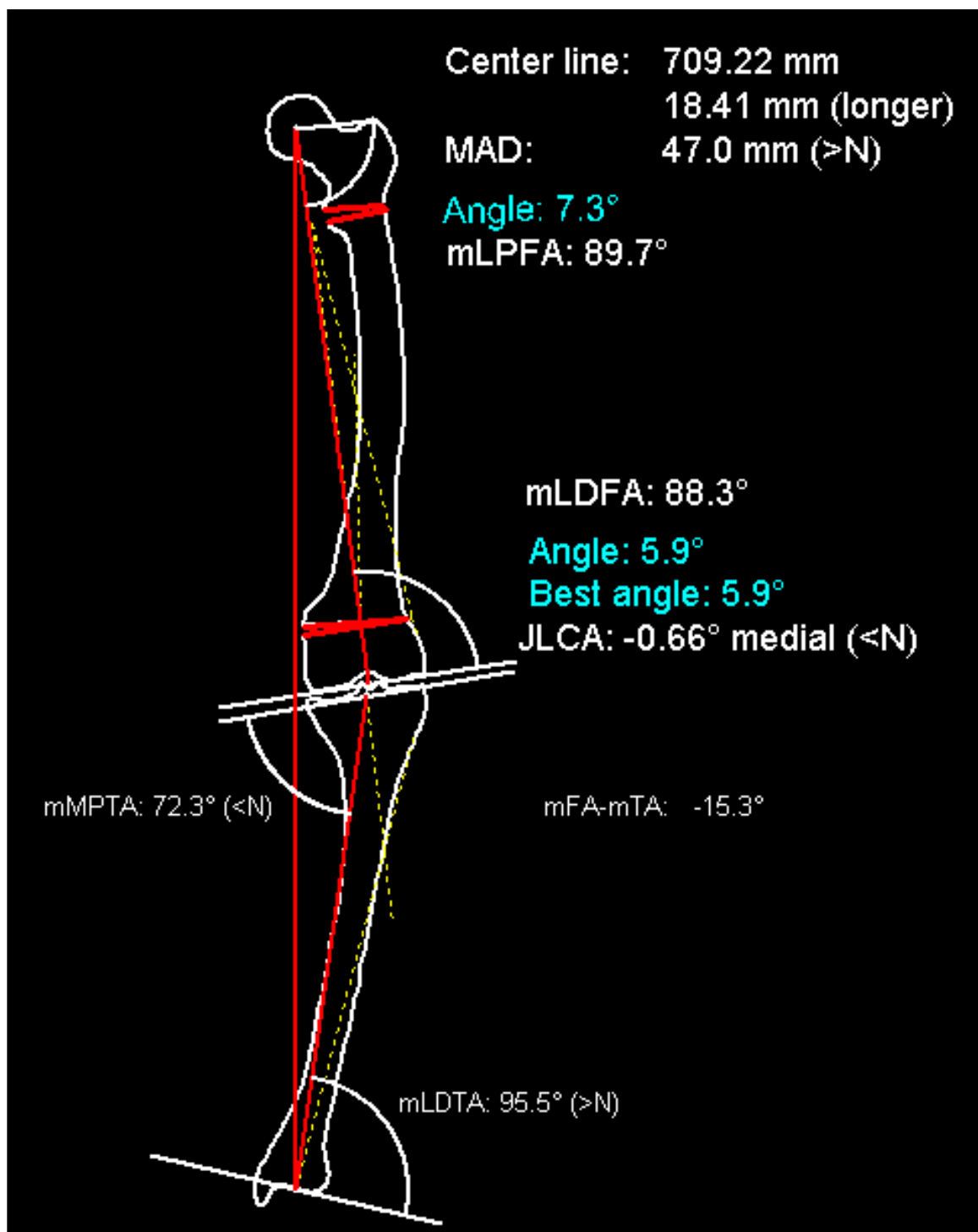

 L: Start moving rotation center
 R: Accept/Reject planning
 Osteotomy tool
 Attention: Osteotomy on the original and NOT on a preview!

- L •** With the left mouse button, confirm the function. Attached to the mouse pointer, the line appears. Drag the mouse pointer to the desired position on the **original image**.
- L •** With the left mouse button, define the new position of the **CORA 2**.
NOTE: by choosing the new position of the CORA2 subsequently the kind of the angle and a possible translation will be actually calculated:
Open wedge means the CORA is near to the medial corticalis
Closed wedge means the CORA is near to the lateral corticalis
With translation means the CORA does not touch the tbl
Without translation means the CORA is on the tbl



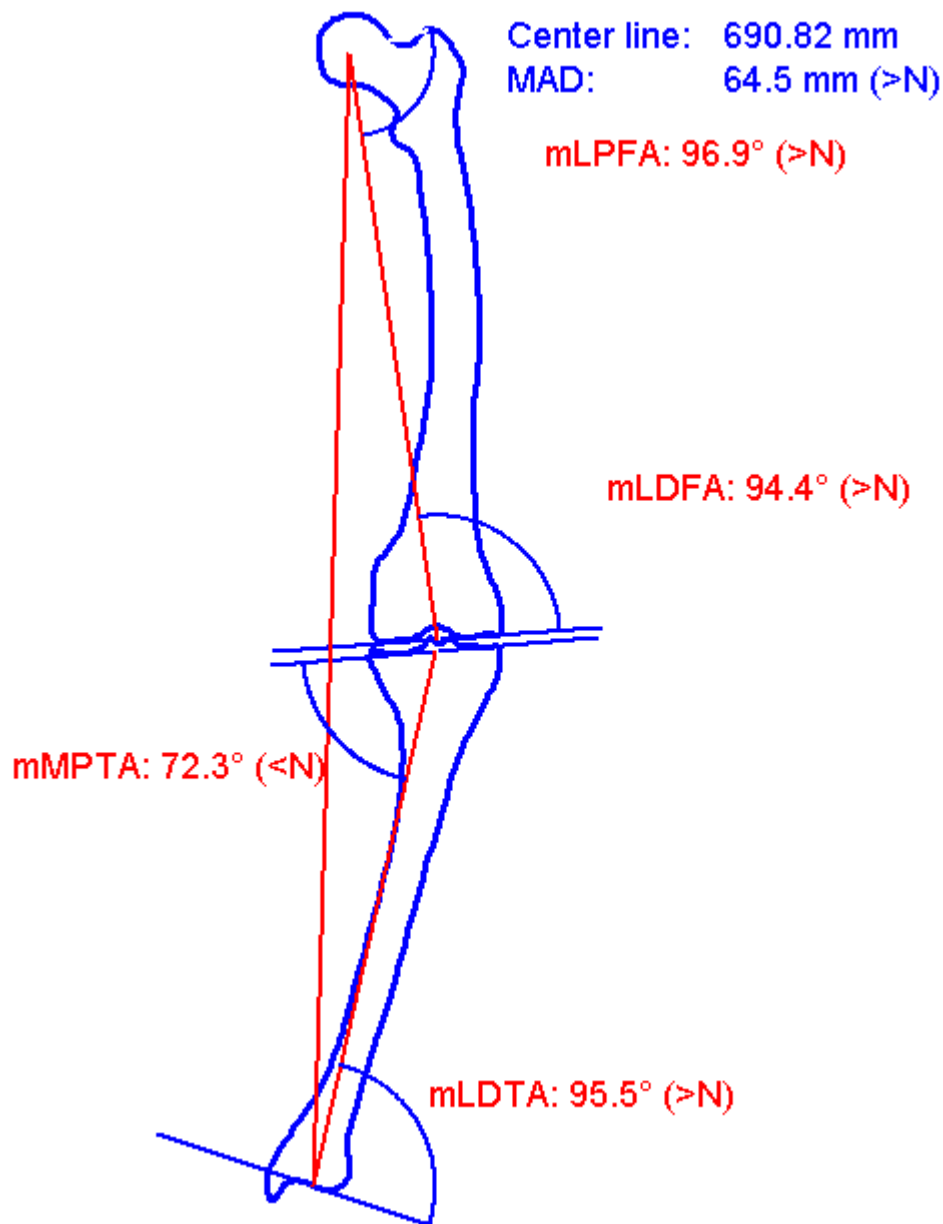
- L** • With the left mouse button, repeat the procedure.
- R** • With the right mouse button, open the window for Apply, Reject and Back. Choose **Apply**.

The second Osteotomy is shown. All values are calculated.



3. Osteotomie on the tibia after correcting the femur

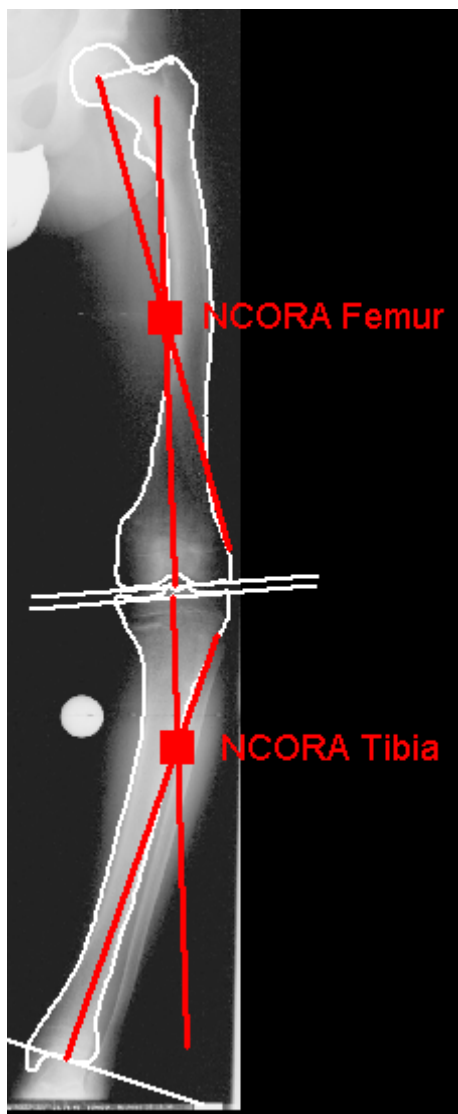
Requirements: After having corrected the femoral deformity an optimal result is not achieved. A tibial correction is necessary. The preoperative analysis had determined a femoral deformity as well as a tibial deformity.



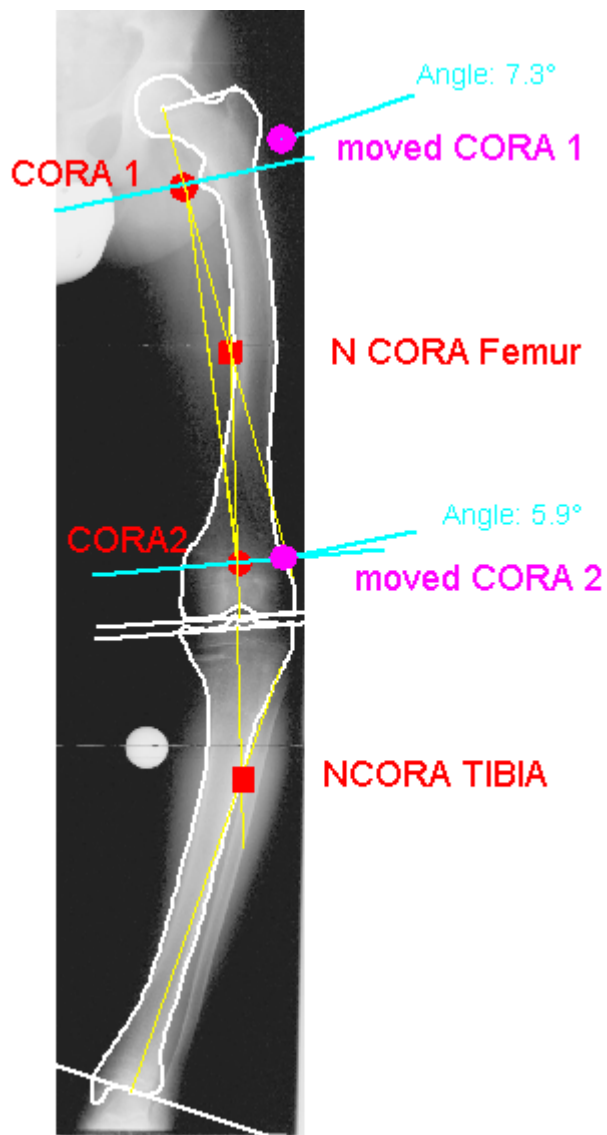
You get the preview preoperative with the function:

- Präop. dimensions AP

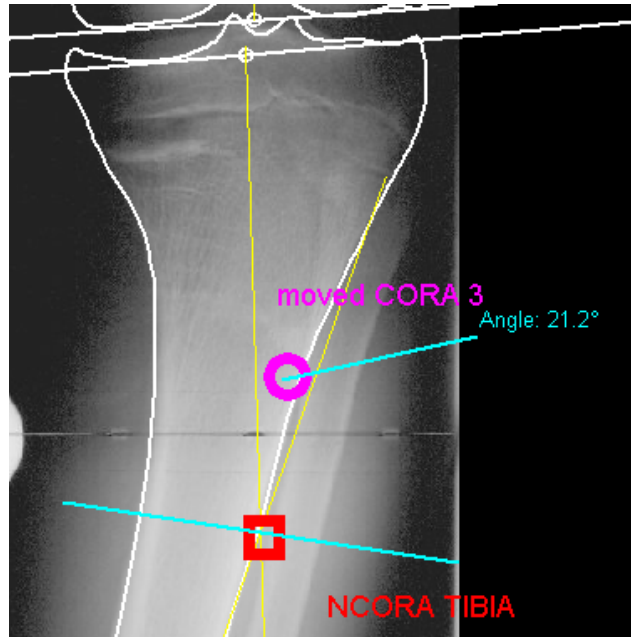
Autos by Dr. Peter Belyaev



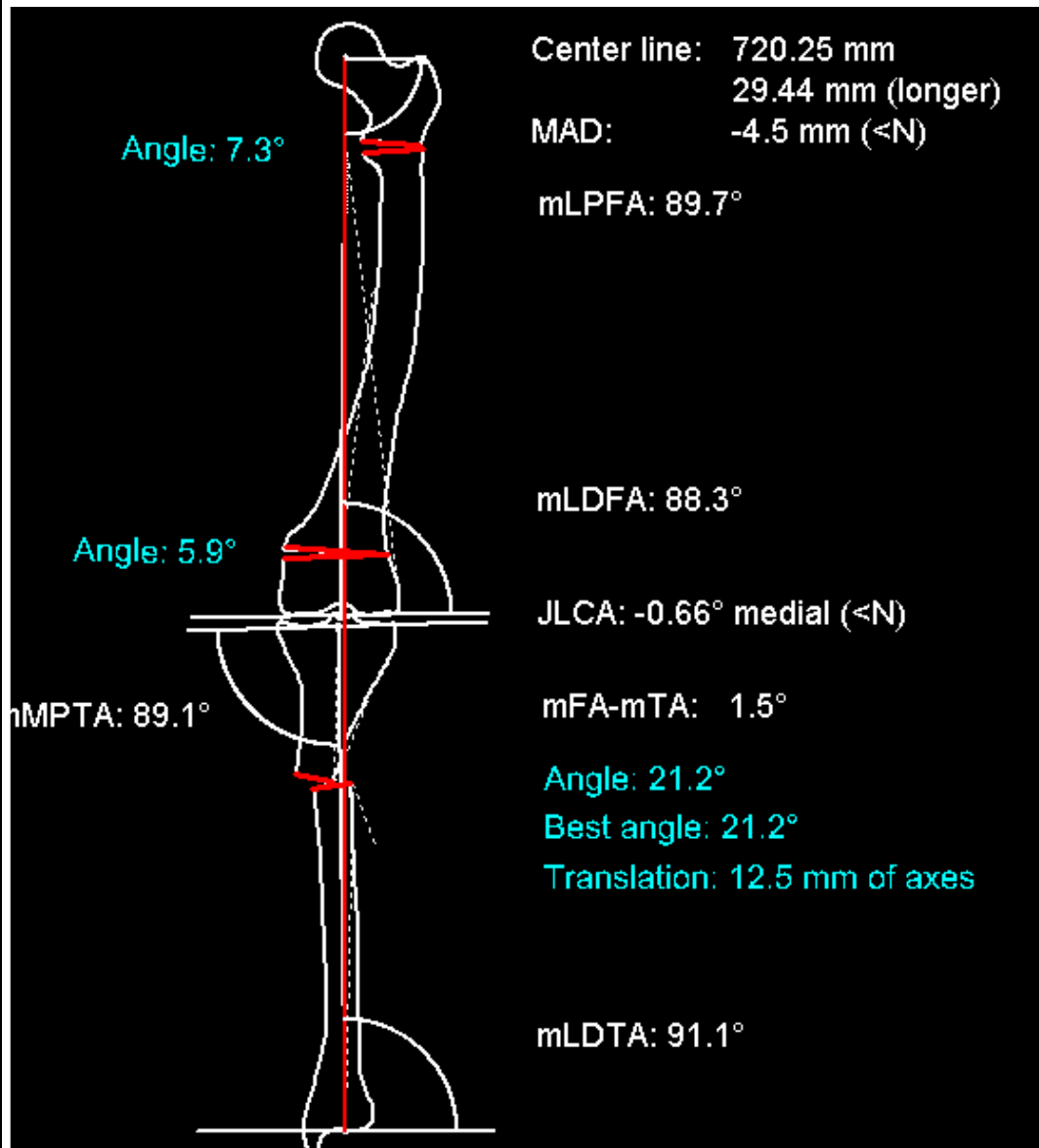
Definition of NCORA
with the function `- Axes by Dror Paley`



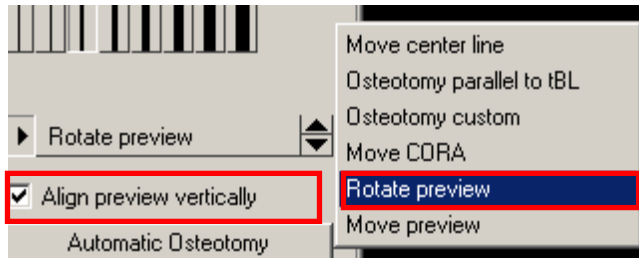
Definition of CORA 1(moved)and
CORA 2 (moved) with the
function `Move CORA`



NCORA is moved and placed on the Ibl



Step15g Rotate preview **15g**



Requirements: The preview is not yet finally applied.
Result: The preview will be turned and is shown in a tilted position.

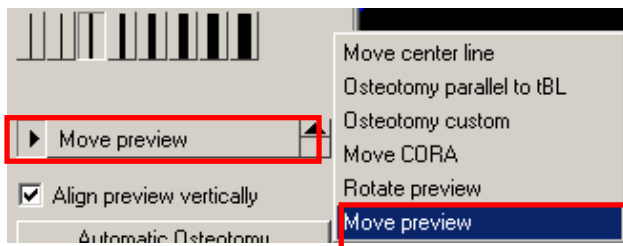
NOTE: The function **Align preview vertically** is always automatically activated. By deactivating this function you will get a tilted preview. By activating the function again the preview will be again shown in the aligned vertical position.

You deactivate the function **Rotate preview**.



- L•** With the left mouse button, grab the preview somewhere. By moving the mouse the preview is turned to the desired position.
- L•** With the left mouse button, confirm the new position. This procedure can be repeated.
- R•** With the right mouse button, open the window for Apply, Reject and Back. Choose **Apply**.
- M** Define the position of the mouse pointer **Free** of your choice.

Step 15h Move preview **15h**



Requirements: The preview is not yet finally applied.
Result: The preview will be moved to a new position on the screen without being turned.

You activate the function **Move preview**.



- L•** With the left mouse button, grab the preview somewhere. By moving the mouse the preview is moved to the desired position.
- L•** With the left mouse button, confirm the new position. This procedure can be repeated.
- R•** with the right mouse button you open the window for Apply, Reject and Back. Choose **Apply**.
- M** Define the position of the mouse pointer **Free** of your choice.

Procedure with an sagittal view

Step 17 Show ap and sagittal images together

17

Modules

Planning info ...

► Osteotomy Dror Paley

Frontal (AP)

- Draw outlines
- Hip joint center
- Circle by 3 points
- CCD-angle
- Free
- Greater trochanter
- **Fossa Piriformis (for aMP...**
- Knee base femur
- Knee base tibia
- Ankle joint base
- **FSA (for AMA)**
- Präop. dimensions AP
- Axes by Dror Paley
- OSTEOTOMY

Sagittale (ML)

- **Draw outlines**
- **Prox. 2/3 center of femur**
- **KJ femur ML**
- **KJ tibia ML**
- **Ankle joint ML**
- Präop. dimensions ML
- Axes by Dror Paley
- OSTEOTOMY

Measure OP-relevant data

- APEX-/Deformity angle
- **Measure angles**
- **Measure distances**

Plates/Angles/Nails

Screws

Requirements: You have an image of the tibia showing the ap view and a second image showing the sagittal view. Both images have a reference on it for scaling.

Result: Both images are scaled and show that part, which is necessary for planning.



NOTE:

For the ap view, the Orthopaedic Application needs the knee base femoral and tibial and the ankle joint.

For the sagittal view the Orthopaedic Application needs the distal femur, the Knee base femoral and tibial and the ankle joint

NOTE: We recommend storing this image on your local store to avoid unintentional loss or deletion.

WARNUNG

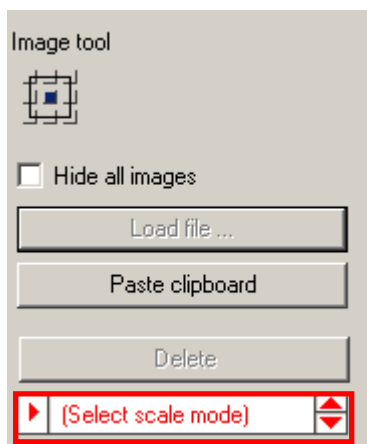
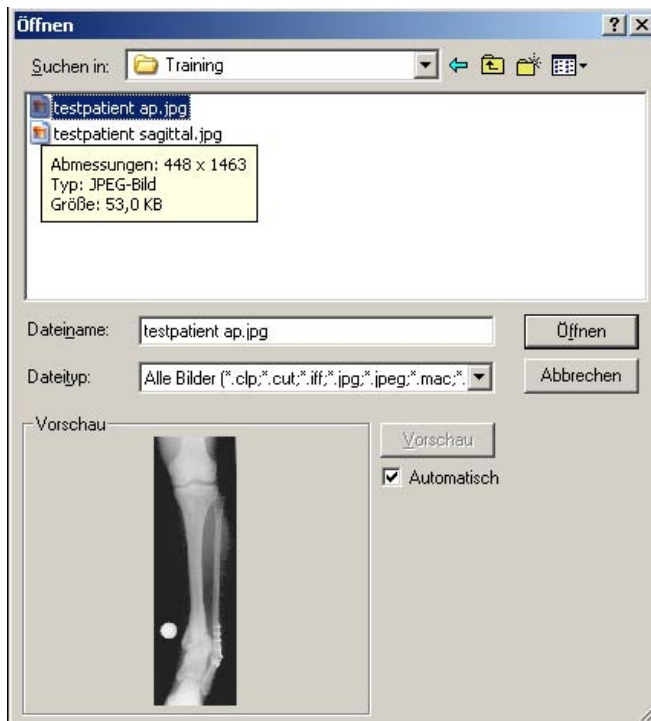
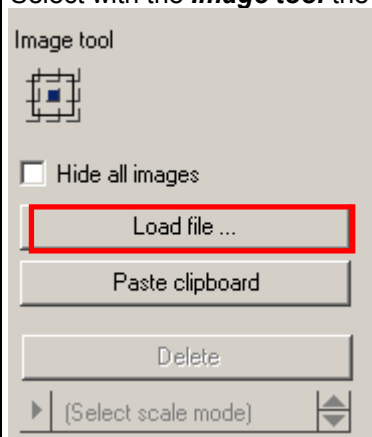
A lead scale has to be shown on both images supposed to planning at the height of the longitudinal axes of femur and tibia for calibration purposes.

Procedure

Activate the function **Insert images**.



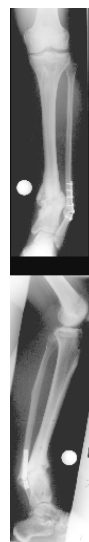
Select with the **Image tool** the desired ap image.



Select the scale mode and scale the image.

Afterwards you load the desired sagittal image and scale it the same way.

Place both images on a position on the screen and go on with the next step.



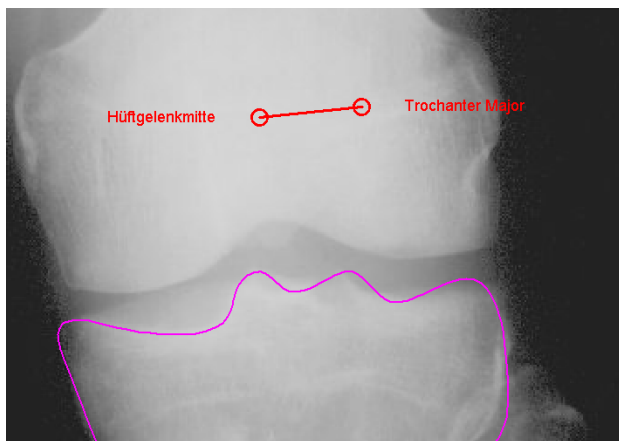
Step 18 Draw outlines and joint centres ap **18**

- Frontal (AP)*
- Draw outlines
 - Hip joint center
 - Circle by 3 points
 - CCD-angle
 - Free
 - Greater trochanter
 - Fossa Piriformis (for aMP...)
 - Knee base femur
 - Knee base tibia
 - Ankle joint base
 - FSA (for AMA)
 - Präop. dimensions AP
 - Axes by Dror Paley
 - OSTEOTOMY

Requirements: The distal femur ap and the tibia ap are shown and the image is scaled.

Result: The tibia outline is drawn and the following joint centres are defined:

1. Hip joint center (formally refer to the picture below)
2. Trochanter Major (formally refer to the picture below)
3. Femoral knee base center
4. Tibial knee base center
5. Ankle joint center

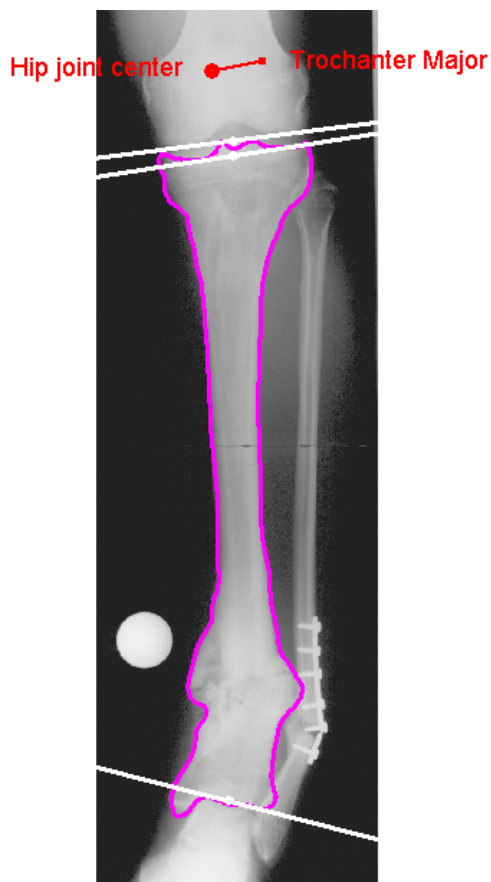


Start with the ap image first and activate the Frontal (ap) functions

NOTE:

Place the hip joint center **Free** of your choice and position it formally on the distal femur.

The position and direction of the **Trochanter Major** indicates the body side. The Orthopaedic Application recognizes the left or the right body side.



Step 19 Define axes by Dror Paley **19**

If it is helpful draw the preoperative dimension ML (medial-lateral) first.

Präop. dimensions AP
- Axes by Dror Paley

Requirements: All joint centres are defined.
Result: The axes by Dror Paley are inserted automatically.

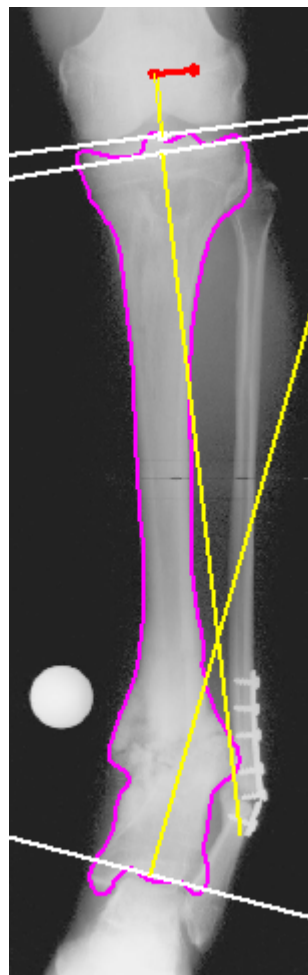
The result shows the mechanical axes and the center of deformity CORA.

NOTE:

Afterwards the deformity in the ap view
 Correlates with the deformity in the sagittal
 view.

CAUTION:

A correct result of the APEX can only be
 achieved if both deformity centres
 (ap and sagittal) have approximately
 the same level, e.g. at the distal tibia
 or at the proximal tibia.



Step 20 Draw the outlines and the joint centres sagittal **20**

Sagittale (ML)

- Draw outlines
- Prox. 2/3 center of femur
- KJ femur ML
- KJ tibia ML
- Ankle joint ML

- Präop. dimensions ML

- Axes by Dror Paley

- OSTEOTOMY

Measure DIP-relevant data

- APEX-/Deformity angle

- Measure angles

- Measure distances

Plates/Angles/Nails

Screws

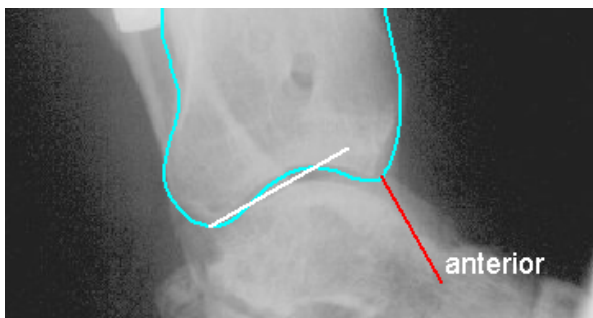
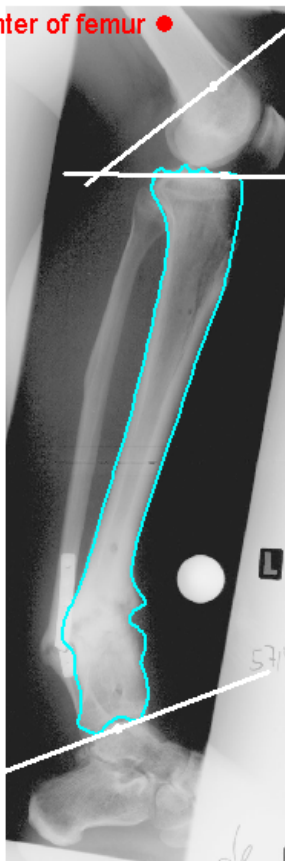
Requirements: The distal femur sagittal and the tibia sagittal are shown and the image is scaled.

Result: The tibia outline is drawn and the following joint centres are defined:

6. Hip joint center (formally refer to the picture below)
7. Femoral knee base center
8. Tibial knee base center
9. Ankle joint center

NOTE: The *Proximal. 2/3 center of femur* indicates the anatomical axis of the visible femoral part. Place the center in the middle of the most proximal visible part of the femur. The more of the femur is visible, the more exact the Orthopaedic Application is able to calculate.

proximal 2/3 center of femur ●



CAUTION:

When you have drawn the basic line of a joint and you will mark the anterior or posterior condyles, to define the joint center correctly, an instruction **anterior** appears.

Please place always the **first** mark on the **anterior** outline.

Step 21 ml – Define axes by Dror Paley **21**

If it is helpful to draw the preoperative dimension ML (medial-lateral) first.

Präop. dimensions ML
Axes by Dror Paley

Requirements: All joint centres are defined.

Result: The axes by Dror Paley are defined automatically.

The result shows the axes and the center of deformity.

The result shows the mechanical axes and the center of deformity CORA.

NOTE:

Afterwards the deformity in the ap view correlates with the deformity in the sagittal view.

CAUTION:

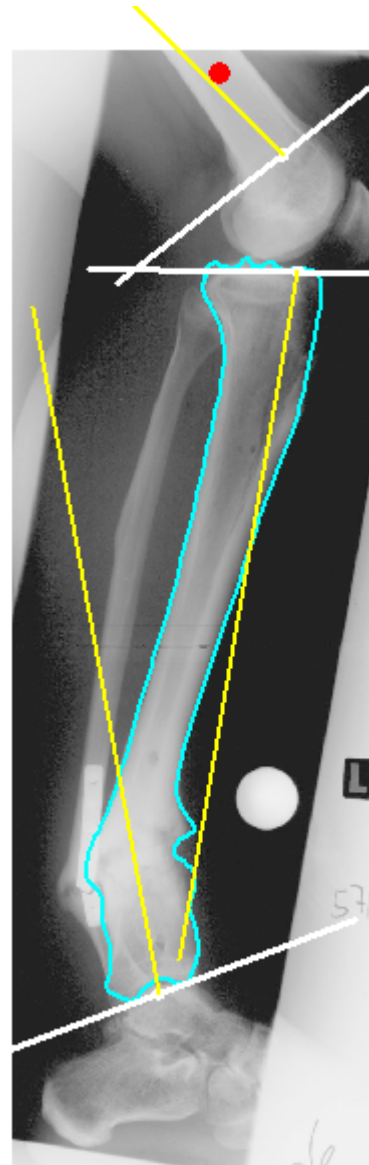
A correct result of the APEX can only be achieved if both deformity centres (ap and sagittal) have approximately the same level, e.g. at the distal tibia or at the proximal tibia.

For calculation of the APEX and the real oblique, all requirements are met.

If necessary now you can change the **Axis by Dror Paley** or you can **Osteotomy**.

For more information about that refer to the **Step 15**.

The procedures for the ap view and the sagittal view are the same.

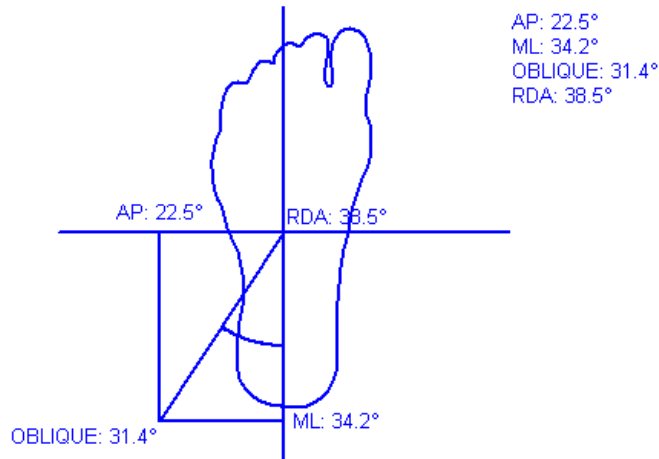


Step 22 Calculation of APEX, Oblique and Real Deformity

22

- APEX-/Deformity angle

Requirements: Both CORAs are defined and have almost the same level.
Result: A schematic view of the APEX, the Oblique and the Real deformity angle is drawn automatically.



Activate the **APEX Deformity angle**

- L: Select deformity in AP-plane
- R: Exit function
- M: Axes

APEX-/Deformity angle
 Angle: 21.1° varus

NOTE: Make sure that the CORA is defined by the intersection point of the mechanical axes. Move the mouse pointer near to the CORA tbl, and lbl appear automatically.

- L** With the left mouse button, confirm the CORA of the ap view.
- R** With the right mouse button, exit the function and go back to the **Module Assistant**.
- M** The snap to **Axes** mode is preselected automatically.

The deformity angle and the direction are shown in the **Information Area**.

- L: Select deformity in ML-plane
- R: Back
- M: Axes

APEX-/Deformity angle
 Angle: 21.1° varus

NOTE: Make sure that the CORA is defined by the intersection point of the mechanical axes. Move the mouse pointer near to the CORA tbl, and lbl appear automatically.

- L** With the left mouse button, confirm the CORA of the sagittal view.
- R** with the right mouse button you go back to **Select there deformity in the AP-plane**.
- M** The snap to **Axes** mode is preselected automatically.

The deformity angle and the direction are shown in the **Information Area**.

Attached to the mouse pointer you have the schematic view of the result.

- L: Place APEX
- R: Exit function
- M: Free

APEX-/Deformity angle

- L** With the left mouse button, place the schematic view on the desired position.
- R** With the right mouse button, exit the function and go back to the **Module Assistant**.
- M** define the position of the mouse pointer **Free** of your choice.

Planning and view of the APEX is shown.

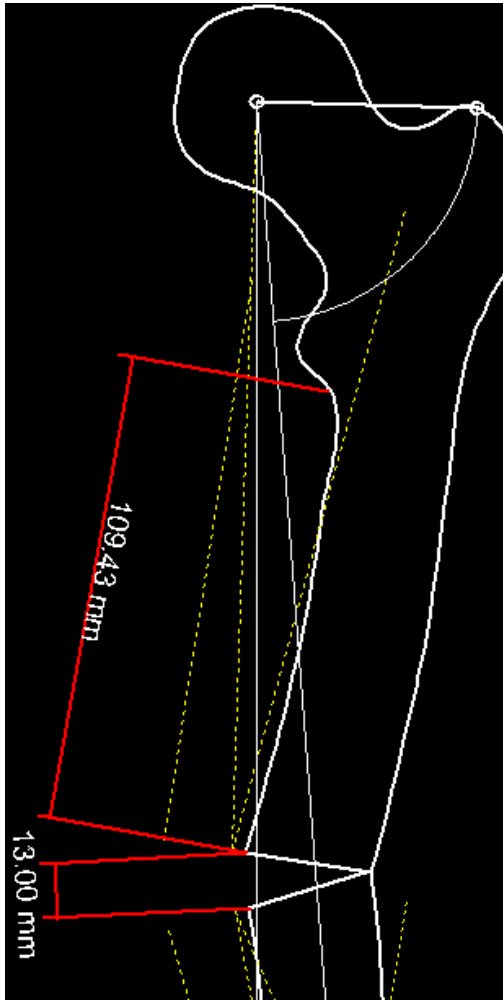
Measure OP relevant data

- Measure angles
- Measure distances

Requirements: The planning is finished.

Result. Angles and distances which are helpful for an intraoperative orientation are displayed in degrees and mm.

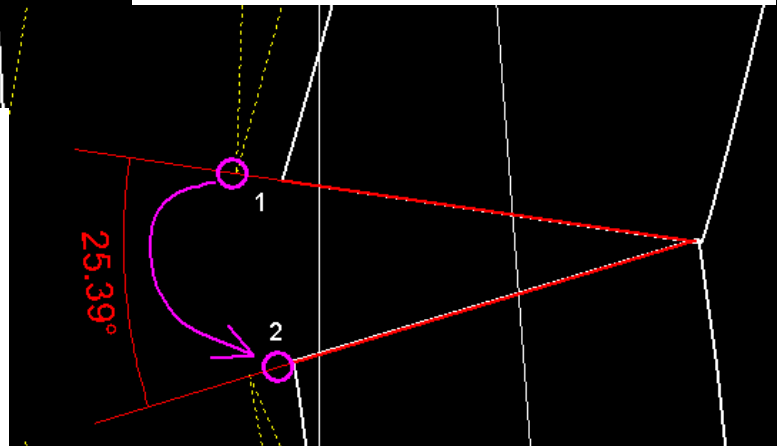
You are in the function **Measure distances**.

**NOTE:**

Make sure that an angle is measured **anti-clockwise**.

Refer to the picture below.

First mark the side 1 und afterwards side 2.



Measurement of a distance:



L: 1. Point
R: Exit function
M: Free

Dimension parallel

- L** ● With the left mouse button, choose the 1st point of the measurement line.
- R** With the right mouse button, go back to the **Module Assistant**.
- M** Define the position of the mouse pointer **Free** of your choice.



L: 2. Point
R: Back
M: Free

Dimension parallel
Length: 609.5 mm

- L** ● With the left mouse button, choose the 2nd point of the measurement line.
- R** With the right mouse button, go back to point 1.
- M** Define the position of the mouse pointer **Free** of your choice.

NOTE:

If useful press the key **P** to change into the mode **Point** and the snap to point mode is activated, or press **L** for line, **E** for end of a line and **S** for intersection of 2 lines.

Before you choose the 2nd point of the measurement the value of the distance in mm is indicated on the screen and in the information area. It changes while moving the mouse cursor.



L: Place dimension text
R: Back
M: Free

Dimension parallel
Length: 609.9 mm

- L** ● With the left mouse button, position the measurement result on the desired position of the screen

Measurement of an angle:



L: Select 1. line
R: Exit function
M: Line or Element

Dimension angle

- L** ● With the left mouse button, choose the 1st side of the angle.
- R** with the right mouse button you go back to the **Module Assistant**.
- M** The snap to **line or element** mode is selected automatically.



L: Select 2. line
R: Back
M: Line or Element

Dimension angle

- L** ● With the left mouse button, choose the 2nd side of the angle.
- R** with the right mouse button you go back to the 1st side of the angle.
- M** The snap to **line or element** mode is selected automatically.

Move the angle and its value to the desired position at the screen.



L: Place dimension text
R: Back
M: Free

Dimension parallel
Length: 609.9 mm

- L** ● With the left mouse button, position the measurement result on the desired position of the screen.

The measurement of the angle is defined.

Further reading

For the module Osteotomy

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Abbreviations

a	anatomical
ACA	Angle of Correction of Angulation
aLDFA	anatomical Lateral Distal Femoral Axis
AMA	Anatomical Mechanical Angle (angle between anatomical and mechanical axis)
aMLFA	anatomical Medial Lateral Femur Axis
aMPFA	anatomical Medial Proximal Femur Axis Center Line
D	distal
FNA	Femoral Neck Axis
FNA	Femoral neck axis
FSA	Femurshaftaxis
FSA-mTA	Femur Shaft Axis (anatomical)–mechanical Tibia Axis
HJC	Hip Joint Center
HPKI	acetabulum-femoral head index according to Heymann and Herndorn
JLCA	Joint Line Conversion Angle (angle between KJL-F and KJL-T)
KJL-F	Knee Joint Line–Femur (proximal knee base)
KJL-T	Knee Joint Line–Tibia (distal knee base)
L	Lateral
m	mechanical
MAD	Mechanical Axis Deviation
mFA-mTA	mechanical Femur Axis–mechanical Tibia Axis
Mikulicz	center line
mLDFA	mechanical Lateral Distal Femoral Axis
mLDTA	mechanical Lateral Distal Tibia Axis
mLPFA	mechanical Lateral Proximal Femoral Axis
mMPFA	mechanical Medial Proximal Tibial Axis
RDA	Real Deformity Angle (only for module Osteotomy II , here not relevant)
TL	Traglinie (Center line)