OrthoPilot®
OrthoPilot KneeSuite™ – TKA 5.1
Total Knee Arthroplasty, Columbus®, VEGA System®, Columbus IQ

Aesculap Orthopaedics


OrthoPilot
The OrthoPilot System assists in the precise implantation of knee and hip endoprostheses. Integration in the surgical workflow as well as minimal prolongation of operation time were essential criteria in the development of the OrthoPilot system. At the same time, we focused on a navigation system that is non-traumatic for the patient. From the beginning, a method was developed that eliminates use of CTs and MRIs and the X-ray exposure or the expenses that these entail and extends surgery time as minimally as possible.

Indications for Use:
The OrthoPilot Next Generation Navigation Platform is a system for computer-aided navigation of surgical instruments. Its purpose is to position endoprosthesis in arthroplasty in the patient. It aids the surgeon in accurately positioning the cutting guides, drills and reamers for total endoprosthesis replacement surgery and provides intraoperative measurements of bone alignment. It indicates angles and positions for implant placement.

For more information about indications and contraindications, please refer to the Instructions for Use posted on www.aesculapimplantsystems.com.

Benefits:
- CT Scan not required
- Ergonomic instruments precisely aligned to the surgery
- User-friendly navigational flow integrates itself easily into the operating room and procedure
- Proven precision of implant alignment
- Intraoperative documentation with OrthoPilot
- Numerous studies confirm significantly better alignment
- Routinely used in over 600 hospitals
- Over 300 OrthoPilot publications worldwide
# Table of Contents

1. Instrument Overview ................................................................. 6
   1.1 General Instruments ............................................................. 6
   1.2 Standard and MIOS® Instruments ....................................... 7
   1.3 IQ Instruments ................................................................. 8
2. Preoperative Planning Using Radiographic Images .......................... 9
3. Preoperative Planning ............................................................... 10
4. Preparation of the Patient .......................................................... 12
5. OrthoPilot Setup and Transmitter Position .................................. 13
   5.1 OrthoPilot-Positioning ...................................................... 13
   5.2 Femoral Transmitter ............................................................ 13
   5.3 Tibial Transmitter ............................................................... 14
   5.4 Camera Adjustment ............................................................ 15
6. Entering Patient-Related Information .......................................... 16
7. Anterior Cortex Point and Posterior Condyle Line .......................... 17
   7.1 Recording the Medial and Lateral Posterior Condyle ............... 17
   7.2 Recording the Anterior Cortex Point ................................... 17
8. Recording the Epicondylar Line – Option ..................................... 18
9. Palpation of the Tibial Reference Points ...................................... 19
   9.1 Reference for the Medial Cutting Height Indicator ................. 19
   9.2 Reference for the Lateral Cutting Height Indicator ............... 19
10. Determination of Tibia Center ..................................................... 20
11. Ankle Joint Palpations ............................................................... 21
   11.1 Medial and Lateral Malleolus ............................................ 21
   11.2 Anterior Ankle Joint Point .................................................. 21
12. Registration of the Hip Joint Center ........................................... 22
13. Registration of the Knee Joint Center .......................................... 23
14. Representation of the Mechanical Leg Axis .................................. 24
15. Resection of the Tibia Plateau ..................................................... 25
16. Reassessing the Tibial Resection ............................................... 26
17. Condyle Recording ................................................................. 27
18. Optimization of Anterior Cortex ............................................... 28
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>19. Measuring the Joint Gap in Extension and Flexion</td>
<td>29</td>
</tr>
<tr>
<td>19.1 Measuring the Joint Gap in Extension</td>
<td>29</td>
</tr>
<tr>
<td>19.2 Measuring the Joint Gap in Flexion</td>
<td>29</td>
</tr>
<tr>
<td>20. Femoral Planning</td>
<td>30</td>
</tr>
<tr>
<td>20.1 In Extension</td>
<td>30</td>
</tr>
<tr>
<td>20.2 In Flexion</td>
<td>31</td>
</tr>
<tr>
<td>20.3 Display and Control Elements (Center)</td>
<td>31</td>
</tr>
<tr>
<td>20.4 Control Elements (Bottom)</td>
<td>32</td>
</tr>
<tr>
<td>21. Distal Femur Resection, Control and Rotational Orientation</td>
<td>33</td>
</tr>
<tr>
<td>21.1 Distal Femur Resection</td>
<td>33</td>
</tr>
<tr>
<td>21.2 Reassessing the Distal Resection</td>
<td>34</td>
</tr>
<tr>
<td>21.3 Setting the Rotational Alignment</td>
<td>35</td>
</tr>
<tr>
<td>22. Mechanical Axis</td>
<td>36</td>
</tr>
<tr>
<td>23. Femur First Technique</td>
<td>37</td>
</tr>
<tr>
<td>23.1 Condyle Recording/Recording Whiteside’s Line</td>
<td>37</td>
</tr>
<tr>
<td>23.2 Optimization of Anterior Cortex</td>
<td>38</td>
</tr>
<tr>
<td>23.3 Distal Femur Resection</td>
<td>39</td>
</tr>
<tr>
<td>23.4 Reassessing the Distal Resection</td>
<td>40</td>
</tr>
<tr>
<td>23.5 Setting the Rotational Alignment</td>
<td>41</td>
</tr>
<tr>
<td>24. Mechanical Axis</td>
<td>42</td>
</tr>
<tr>
<td>25. Instrument Set Overview OrthoPilot® TKA</td>
<td>43</td>
</tr>
<tr>
<td>26. Software and Consumeables</td>
<td>46</td>
</tr>
<tr>
<td>26.1 Software OrthoPilot TKA FS235</td>
<td>46</td>
</tr>
<tr>
<td>26.2 Consumeable Passive Marker Spheres</td>
<td>46</td>
</tr>
<tr>
<td>27. Schematic Program Flow TKA</td>
<td>47</td>
</tr>
<tr>
<td>27.1 Schematic program flow – Tibia First</td>
<td>47</td>
</tr>
<tr>
<td>27.2 Schematic Program Flow – Femur First</td>
<td>48</td>
</tr>
</tbody>
</table>
# OrthoPilot®

**OrthoPilot KneeSuite™ - TKA 5.1**  
**Total Knee Arthroplasty, Columbus®, VEGA System®, Columbus IQ**

## 1. Instrument Overview

### 1.1 General Instruments

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drill, Drill Sleeve, Screw Length Gauge</td>
<td>Drill, D=3.2 mm</td>
<td>NP615R</td>
</tr>
<tr>
<td>Drill sleeve</td>
<td>NP616R</td>
<td></td>
</tr>
<tr>
<td>Screw length gauge</td>
<td>NP281R</td>
<td></td>
</tr>
<tr>
<td>Tissue Protection Sleeve, Bicortical Screws, RB Adapter</td>
<td>MIOS® tissue protection sleeve</td>
<td>NQ941R</td>
</tr>
<tr>
<td>Bicortical screws</td>
<td>NP620R – NP625R</td>
<td></td>
</tr>
<tr>
<td>Rigid Body</td>
<td>NP619R</td>
<td></td>
</tr>
<tr>
<td>Tissue Protection Sleeve, Bicortical Screws, RB Adapter</td>
<td>MIOS® tissue protection sleeve</td>
<td>NQ941R</td>
</tr>
<tr>
<td>Bicortical screws</td>
<td>NP620R – NP625R</td>
<td></td>
</tr>
<tr>
<td>Rigid Body</td>
<td>NP619R</td>
<td></td>
</tr>
<tr>
<td>Passive Transmitters</td>
<td>Yellow</td>
<td>FS633</td>
</tr>
<tr>
<td></td>
<td>Blue</td>
<td>FS634</td>
</tr>
<tr>
<td></td>
<td>Red</td>
<td>FS635</td>
</tr>
<tr>
<td>Pointer, Straight</td>
<td>Pointer, straight</td>
<td>FS604</td>
</tr>
<tr>
<td>Tibia Cut Control Plate</td>
<td>Tibia control plate</td>
<td>NP617R</td>
</tr>
<tr>
<td></td>
<td>Tibia control plate</td>
<td>NP617RM</td>
</tr>
<tr>
<td>Laminar Spreader, Spreading Forceps</td>
<td>Laminar spreader</td>
<td>NE750R</td>
</tr>
<tr>
<td></td>
<td>Spreading forceps</td>
<td>NP609R</td>
</tr>
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</table>
1.2 Standard and MIOS® Instruments*

**Femoral Alignment Block with Foot Plates**

<table>
<thead>
<tr>
<th>Item</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columbus®</td>
<td>NE324T</td>
</tr>
<tr>
<td>Columbus MIOS</td>
<td>NQ954R</td>
</tr>
<tr>
<td>Foot Plates</td>
<td>NE441R/NE442R</td>
</tr>
<tr>
<td>Y Foot Plate</td>
<td>NQ958R</td>
</tr>
</tbody>
</table>

**Tibial Sawing Guide**

<table>
<thead>
<tr>
<th>Item</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard right</td>
<td>NP596R</td>
</tr>
<tr>
<td>Standard left</td>
<td>NP597R</td>
</tr>
<tr>
<td>MIOS right</td>
<td>NQ952R</td>
</tr>
<tr>
<td>MIOS left</td>
<td>NQ951R</td>
</tr>
</tbody>
</table>

**Distal Femoral Sawing Guide**

<table>
<thead>
<tr>
<th>Item</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>NP598R</td>
</tr>
<tr>
<td>MIOS</td>
<td>NQ953R</td>
</tr>
</tbody>
</table>

*Note: Not for VEGA System*. 
1. Instrument Overview (continued)

1.3 IQ Instruments

<table>
<thead>
<tr>
<th>Femoral Alignment Block with Foot Plates</th>
<th>Tibial/Distal Femoral Sawing Guide and RB Adapter, Modular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alignment block</td>
<td>Tibial/femoral sawing guide</td>
</tr>
<tr>
<td>NS320R</td>
<td>NS334R</td>
</tr>
<tr>
<td>Y foot plate</td>
<td>RB adapter, modular</td>
</tr>
<tr>
<td>NQ958R</td>
<td>FS626R</td>
</tr>
</tbody>
</table>

4-in-1 Femoral Sawing Guide and RB Adapter, Modular

| Columbus F1-F2                         | NQ441R – NQ442R                                         |
| Columbus F3-F6                         | NQ443R – NQ446R                                         |
| Columbus F7                            | NQ447R                                                   |
| VEGA System® 4-in-1 Femoral cutting blocks |                                      |
| F1–F8                                  | NS321R – NS328R                                         |
| Columbus 4-in-1 Femoral cutting blocks |                                      |
| F1–F8                                  | NQ1041R – NQ1048R                                        |
2. Preoperative Planning Using Radiographic Images

The OrthoPilot® system and the TKA software can be used in all cases where total knee arthroplasty with a total knee endoprosthesis is indicated. There must be sufficient bone quality and hip joint mobility.

Note: For more information about indications and contraindications, please refer to the instructions for use posted on www.aesculapimplantsystems.com.
Aesculap considers it necessary to carry out an adequate preoperative planning based on the following X-ray images:
- Whole leg image in standing position
- Knee joint in an A/P projection
- Knee joint in lateral projection
- Tangential image of the patella

Selected information which can be obtained on the basis of the X-ray images:
- Axis deviation
- Implant alignment, joint gap, ML implant size
- Slope, A/P implant size
- Patella shape, joint gap
- Rotational position
The analysis of the need for a total knee prosthesis is essential in the preoperative planning. In addition to the standard radiological examinations, the surgeon should take the following points into consideration before performing a total knee arthroplasty surgery:

- Soft tissue situation
- Functionality of the extensor mechanism
- Bone preservation
- Restoration of good axis orientation
- Functional stability
- Restoration of the joint line

The surgeon can obtain the following information when analyzing the X-ray images with the help of the X-ray templates of the Aesculap prosthesis systems Columbus® and VEGA System®.

- Angle between anatomic and mechanical femur axis
- Resection height
- Implant size
Positioning and sterile draping of the patient is carried out according to the standard procedures which are also applied in the conventional technique. Aesculap recommends using a leg holder, which facilitates leg control during the various phases of the surgery.

In order to record the register points and carry out all the necessary bone cuts, it is necessary to change the leg position several times. The leg holder enables the knee position to be changed between full extension and full flexion.

TIP
To facilitate mobilization of the quadriceps, bring the knee to 100° of flexion prior to activating the tourniquet. If a pad is used, make sure that it does not hinder full circulation of the hip joint which is required for registering the femoral head center.
5. OrthoPilot® Setup and Transmitter Position

5.1 OrthoPilot Positioning

When positioning the OrthoPilot, ensure that the physician has an unobstructed view of the screen at all times. Unit or camera can be positioned either on the opposite side of the leg to be operated on (contralateral) or on the same side (ipsilateral).

In many cases, it has proven beneficial to position the camera at shoulder height on the opposite side of the patient and align at approx. 45° to the operating field.

TIP
Aim the laser pointer in the handle of the camera at the knee joint to be operated on while the leg is in approximately 90° of flexion. The camera alignment can be adjusted at any stage of the operation except during determination of the hip center.

TIP

5.2 Femoral Transmitter

In general: the transmitter should be positioned so that it is visible for the camera during the entire operation. The femoral transmitter must be fixed on the femur with the aid of 4.5 mm cortical screws and the rigid body (RB) (NP619R) at about 10 cm proximal to the joint line.

The bicortical screw is pre-drilled by using a 3.2 mm drill (NP615R) through the drill sleeve (NP616R). Then, the length of the necessary bicortical screw can be determined with the help of the scale on the drill or the measuring instrument (NP281R) by hooking on the opposite cortical and reading out the dial. The rigid body (NP619R) is pushed forward – with MIOS®- and IQ-Instruments optionally through the tissue protection sleeve (NQ941R) – and brought into contact with the bone. Then, one of the bicortical screws (NP620R - NP625R) is introduced first mechanically- the last turns are performed with the help of a manual screwdriver. The transmitter adapter should point to the head of the hip, inclined towards the camera. It is recommended to test the secure fit.

TIP
The tip of the pointer with a length of about 10 cm can serve as a guide for the distance to the joint.
5.3 Tibial Transmitter

Through a separate, approximately 1 cm long incision, about 10 cm distal to the joint line, fix an RB (NP619R) to the tibia after pre-drilling with the 3.2 mm drill (NP615R) through the drill sleeve (NP616R) and after determining the length of the bicortical screw as described in the previous Chapter 5.2. The last turns of the screw are performed with a manual screwdriver. The possibilities of transmitter fixation are various. Two selected examples are displayed in Figures 9 and 10.
5.4 Camera Adjustment

The field of view of the camera is shown on the screen as a cylindrical volume. The transmitters within the field of view of the camera are displayed in this cylinder capacity as colored balls (corresponding to the color coding), with their respective identification letters:

- Transmitter on the femur: Red ball with identification letter "F"
- Transmitter on the instrument: Yellow ball with identification letter "P"
- Transmitter on the tibia: Blue ball with identification letter "T"

**TIP**

When all three transmitters are at an appropriate distance from the camera, the camera’s field of view is bordered in green on the screen. The distance from the camera to the transmitters is given in meters.

**TIP**

When aligning the camera, take into consideration that the leg is extended, abducted or adducted during the operation. The camera must be set up so that it can register the transmitters in every position. The OR staff can readjust the camera to improve the visibility of the transmitters at any time during surgery – except during the step “Registration of the hip joint center.”

Attach the passive transmitter (FS635) marked in red to the femoral rigid body (RB) adapter. Attach the passive transmitter (FS634) marked in blue on the tibial rigid body (RB) adapter. Attach the yellow passive transmitter (FS633) to the respective instruments required at each stage.

**Option:** The screen for positioning the camera can be accessed at any time via the user-toolbox-menu in the upper left corner of the screen (default). As an option during the software installation, the camera adjustment screen can be set to always occur after the patient data screens in order to enforce the adjustment.

**Fig. 11**

**Fig. 12**

Average distance: 1.9 m
6. Entering Patient-Related Information

**Entering Hospital-Related Data**
- Name of the Surgeon
- Name of the Hospital/Department

**Entering Patient Data**
- First Name
- Last Name
- Date of Birth
- Gender

**Side**
- Left
- Right

**Implant**
- Columbus®
- VEGA System®

**Tool Set**
- Standard
- IQ
- MIOS®

**Tracking Technology**
- Passive
7. Anterior Cortex Point and Posterior Condyle Line

7.1 Recording the Medial and Lateral Posterior Condyle
Place the tip of the pointer in the middle of the posterior medial condyle. The point selected is the one lying furthest posterior, (i.e. the one with the greatest distance from the anterior femoral cortex). The recording on the lateral side is made in the same manner.

7.2 Recording the Anterior Cortex Point
This point is located at the place where the anterior shield of the prosthesis will end proximally. In the medio-lateral direction, the most anterior point should be palpated. The proposal for the size of the femoral component is calculated on the basis of the distance between this point and the posterior condyle. This point is used later on to determine whether there is a danger of sawing into the anterior cortex (notching).
The epicondylar line is recorded via recording of the medial and lateral epicondyle. Therefore, the corresponding option must be activated. In a later program step, the user can decide whether to use the epicondylar line or the connecting line between the palpated posterior condyles as reference line for rotational alignment of the femoral component.

Place the tip of the pointer first on the medial, then on the lateral epicondyle. The recording is made in each instance by pressing the right pedal.

Option: By default, the palpation of the epicondyles is turned off. If needed, the palpation of the epicondyles in the tibia first workflows can be activated.
9. Palpation of the Tibial Reference Points

9.1 Reference for the Medial Cutting Height Indicator
In this step, the reference point for the medial cutting height indicator is recorded. It is recommended to use significant landmarks for palpation such as the deepest points of the defects or the surface of the joint.

9.2 Reference for the Lateral Cutting Height Indicator
In this step, the reference point for the lateral cutting height indicator is recorded. It is recommended to use significant landmarks for palpation such as the deepest points of the defects or the surface of the joint.

Option: By default, the palpation of both reference points is provided. Optionally, the software can be triggered in such a way that only one reference point is requested. In consequence, only one reference point is recorded, and in the step “tibial resection”, the cutting height for only this one reference point is shown.
In this step, the center of the anterior edge of the anterior cruciate ligament has been recorded. If there is no cruciate ligament or in the case of degenerative changes, the following point is found:

- In the middle of the medial-lateral diametral line of the tibial head,
- At the transition from the first to the second third of the anterior/posterior diametral line of the tibia head, measured from the anterior edge.
11. Ankle Joint Palpations

11.1 Medial and Lateral Malleolus
Place the pointer at the center of the medial malleolus. The respective point is recorded using the right pedal. The recording on the lateral side is made in the same manner.

11.2 Anterior Ankle Joint Point
For the recording, place the pointer at the anterior edge of the distal tibia as close as possible to the ankle joint gap. The following step is displayed: “Anterior ankle”. This palpation point should lie on the central tibial axis immediately adjoining the ankle joint center. It should be palpated there (as indicated by the white point).

The screen display helps the surgeon to find the anterior ankle point by a percentage display having its origin in the palpation of the medial malleolus. A green “safe zone” is displayed around 49% +/- 5%.

TIP
The second metatarsus/second ray or the extensor hallucis longis tendon can be used as a reference during this step. The percentage indicator serves as a plausibility check. If the anterior point (second ray) lies outside the green security area, it is advisable to repeat the palpation of the malleoli.
12. Registration of the Hip Joint Center

The start screen for registration of the hip joint center is displayed.

Only when the leg is not moving, an upward pointing arrow appears, and the data entry can start with the movement of the femur in the 12 o’clock direction.

**TIP**

The circular movement which is described can be performed in a clockwise or counterclockwise direction.

The femur is moved so that the white circle is moving over the fields, like hands on a clock, arranged in a large circle. As soon as sufficient measurement data for determining the femoral hip center has been registered, the program automatically moves to the next step.

In the case of a twitchy or too large movement, the messages “Incorrect data” or “Too wide movement” may appear, and the movement must be repeated.

**TIP**

The camera must not be moved during this step.

- Avoid transmitting force from the femur to the pelvis.
- Avoid any pelvic movement (Responsibility of the surgeon. If this cannot be avoided, alternative determination of hip center, achieved via longpress of right footswitch, can be performed. This would require an additional RB fixed to the iliac crest.)
- Avoid a hip flexion angle > 45°.
- Ensure the femur transmitter is visible during the entire cycle of movement.
- Ensure unrestricted freedom of circular movement (no obstruction by holding and fixing equipment).
13. Registration of the Knee Joint Center

In this program step, the movement of the transmitter at the femur is tracked in relation to the transmitter at the tibia, and the center of the knee joint is determined.

The message “knee center” is displayed on the screen. By pressing the right pedal, determination of the knee joint center is started. Flexion and extension movements are next carried out with the leg. For this, the leg should be grasped with one hand under the heel.

In order to coordinate the actual movement with the display on the screen, it is recommended to start the movement with the knee in approximately 90° flexed position.

Rotation of the tibia is not mandatory. Nevertheless, rotation at 90° flexion may be carried out to increase accuracy as soon as two arrows are displayed on the screen. Solid arrows indicate that the data was recorded. As soon as sufficient measurement data has been recorded, the software automatically moves on to the next program step. If the maximum range of movement was repeatedly covered (even without inward or outward rotation), the next step can optionally be advanced by the user by pressing the right pedal.
In the following step, the registered axis situation is displayed in coronal and in sagittal view. The axis situation is displayed dynamically while the relationship between the mechanical tibial axis and the mechanical femoral axis is calculated on a moment by moment basis. The system enables dynamic goniometry of the knee joint, including specification of the current axis deviation or flexion position within the scope of movement.

**TIP**

This step can be used as a plausibility check of the abnormal axis position in various flexion positions of the leg and also permits preliminary conclusions to be drawn regarding the ligament situation by applying varus and valgus stress.

**Note:** For the Femur First technique, please see Chapter 23: Femur First technique.
15. Resection of the Tibia Plateau

Depending on which leg is being operated on, attach the tibial cutting block or, respectively, the modular RB adapter of the cutting guide (IQ instruments) to the corresponding transmitter. The exact resection height in relation to the bones of the medial and lateral (program steps "Medial tibia reference" or "Lateral tibia reference") reference points of the tibia can be determined on a proximal or distal basis through the movement of the cutting block. The tibial cutting block can be navigated on the basis of the desired varus/valgus and slope value in relation to the mechanical axis. Aesculap recommends 0° posterior slope for its prosthesis systems.

The tibial cutting guide is initially fixed from the anterior side using two headless screw pins. The cutting guide can now be relocated via the available pin holes in 2 mm steps if this is required.

The block is finally fixed at the desired set resection height, slope and varus/valgus alignment using an additional screw pin with a medially or laterally inclined head. Resection can now be performed.

Due to previous palpations, the provisionally calculated femur size in the anterior-posterior dimension is displayed on top in the center of the screen. In addition, the possible combinations of femur to tibia sizes in combination with the selected prosthesis system are shown.

**TIP**

In order to avoid contamination of the marker spheres on the transmitters, either remove the transmitters or cover them appropriately until resection has been completed.

In many cases, it was beneficial to first adjust the anterior/posterior slope and the cutting height and then correct the varus/valgus around the initially placed pin in order to get closer to the desired position iteratively.
The tibia control plate (NP617R or NP617RM) with attached transmitters serves for reassessing and recording the tibial resection. The actual orientation and position of the resection surface to the mechanical axis with respect to the varus/valgus angle and the tibial slope are displayed on the screen.

The data recorded here using the right pedal is used for further calculations, and it is therefore imperative to record this value afresh if resection of the tibia is repeated.
17. Condyle Recording

The distal and posterior condyles are recorded with the help of the corresponding orientation block with foot plates which must be in contact with both the distal as well as the posterior condyles (four-point contact). The alignment in the sagittal plane is displayed on the right half of the screen. The data capture should take place when the block is located in the sagittal plane perpendicular to the mechanical femur axis (i.e. the display on the screen has a slope of about 0°).

When the epicondyles have been palpated (optionally), the angle between the trans-epicondyle line and the posterior condyle line, which is known over the foot plates in contact with the posterior condyles, is displayed in the middle of the screen. If this value is not plausible, it is recommended to perform again the palpation of the epicondyles.

**TIP**

The four-point contact is essentially important.
The following items are based on it:
- The proposal for the femur component size
- The display of the gap values, in extension and flexion
- The cutting height display for the distal and posterior femur resection
- The rotation display for the femur component.
After the distal and posterior condyles have been recorded, an optimization of the anterior points on the femur with the pointer (FS604) and the respective transmitter takes place. Proceed with the pointer tip on the anterior stem in proximal or distal direction until the two value fields show the same numbers. The value field that is distal to the femur component shows the size of the femur implant in the AP direction. The value field above the femur component shows the size of the femur implant in the proximal/distal direction.

The blue arrows in Figure 30a show what direction the pointer has to be moved in order to obtain appropriate palpation of the anterior point with respect to the A/P and the proximal/distal implant size.

Below, in the middle of the screen, there is a “running display”. Displayed are the femur size and the possible combination of tibia size for the current position of the pointer while moving the pointer proximally or distally on the femur. These combinations are based on the implant system initially selected.
19. Measuring the Joint Gap in Extension and Flexion

19.1 Measuring the Joint Gap in Extension

Before measuring the flexion/extension gap, osteophytes which could influence ligament tension and capsular tension must be removed. With the leg extended as far as possible (0° +/- 5°, depending on the measured tibial slope), introduce the distractor (NP604R) between the tibial resection and the distal femur condyles and force apart with identical force medially and laterally using the spreader forceps (NP609R).

The plates of the distractor must lie flat on the tibial resection surface in order to ensure precise measurement.

The OrthoPilot® screen indicates the medial and lateral gap distances in millimeters and the mechanical leg axis in degrees, revealing possible ligament release as well as the flexion position of the leg. After recording the data by pressing the right pedal, release the distractor and move the leg into a 90° flexion position.

19.2 Measuring the Joint Gap in Flexion

With the leg in 90° +/- 5° flexion (depending on the measured tibial slope), the distractor is again forced apart medially and laterally with identical force using the spreader forceps, and record the gap situation.
20. Femoral Planning

20.1 In Extension

1. Distal femoral cutting height, here both laterally and medially 10 mm, is indicated by blue columns and white numbers.

2. Remaining extension gap after planned installation of implant components of 2 mm laterally and 0 mm medially, is indicated by green columns and green numbers. As soon as the remaining gap distances become negative, they are presented by yellow columns and yellow numbers. A negative/yellow gap distance in clinical terms signifies distension of the soft tissue (e.g. ligaments).

3. Varus/valgus display, here 0°, is indicated by the arc inside the femur and the white number.

4. After pressing the “i-button” at the bottom center of the screen, the previously measured joint gap can be switched on and off as a reminder appearing in gray, as all OrthoPilot reminders do. Measured extension gap here is 12 mm lateral and 9 mm medial.
20. Femoral Planning (continued)

20.2 In Flexion

1. Posterior femoral cutting height, here 8 mm laterally and 11 mm medially, is indicated by blue columns and white numbers.

2. Remaining flexion gaps after planned installation of the implant components, here of 3 mm laterally and 3 mm medially, are indicated by green columns and green numbers or, respectively, by yellow columns and yellow numbers if the remaining extension gap becomes negative. A negative or yellow gap distance in clinical terms signifies distension of the soft tissue (e.g. ligaments).

3. Rotation, here 3° external rotation to the recorded posterior condyles, is indicated by the arc inside the femur and the white number.

4. Anterior cutting height here is 0 mm in relation to the anterior palpated point (position of the anterior femur shield at this measured point). This value turns red as soon as the femoral shield lies below palpated point (notching). (See Chapter 7.2 and Chapter 18.)

5. After pressing the “i-button” at the bottom center of the screen, the joint gap measured in previous steps can be switched on and off as a reminder appearing in gray, as all OrthoPilot® reminders do. Measured flexion gap here is 12 mm lateral and 10 mm medial.

20.3 Display and Control Elements (Center)

1. Femoral implant is shown here as size 4 with distal implant thickness of 9 mm for Columbus®.

2. Total height of tibial component (metal plate with PE inlay) here is 10 mm.

3. Information about the displacement of the joint line to proximal or distal is 1 mm here based on the most prominent distal condyle recorded in the step "record condyles". The jointline display is an option. This option can generally be switched on or off during the installation of the software.

4. Orange crosshairs represent a virtual pointer/virtual mouse which can be controlled by moving the yellow transmitter.

5. After pressing the “i-button”, the flexion and extension gaps measured in previously steps can be switched on and off. They appear in gray color.
20. Femoral Planning (continued)

20.4 Control Elements (Bottom)

1. Recycle bin:
   With a long press on the left pedal, the recycle bin can be activated. All actively modified values are reset to the initial values calculated by the software again. This step is used if a completely new planning is desired. Once the planning screen is left for the following stage, the actively modified values remain. The initial situation can’t be retrieved again by using the recycle bin function.

2. White arrow pointing to the left:
   With a short press on the left pedal, the previous step can be reached.

3. White arrow pointing to the right:
   With a short press on the right pedal, the next step can be reached.

4. Crosshairs:
   With a long press on the right pedal, the "virtual pointer" can be reinitialized if the visibility is poor.

TIP

Once the values are selected on the screen by using the virtual pointer, the arrow keys on the bottom of the screen change in a plus or minus sign. This allows the user to change the selected values with a short press accordingly on the right or left pedal. For advancing to the next step with a short press on the right pedal, no other value (except the white arrow at the bottom right 3) must be selected.
21. Distal Femur Resection, Control and Rotational Orientation

21.1 Distal Femur Resection

The distal femur resection block respectively the modular RB adapter of the sawing guide (IQ instruments) is fitted with the corresponding passive transmitter (FS633). Determine the precise resection height in relation to the bony reference points palpated on the distal femoral condyles medially and laterally by moving the cutting guide in a proximal or distal direction.

The target values are those which were selected during femoral planning. If these values are reached in terms of varus/valgus angle, resection height and slope, the color of the ellipses in which the values are displayed changes to green.

An additional reference point for the approximate resection height is the distal thickness of the femoral implant, displayed at the top center of the screen. Additionally, as an option, the indication of deviation of the measured joint plane from the step “record condyles” is displayed in the center of the screen, here shown as 1 mm.

TIP

In order to avoid contamination of the marker balls on the transmitters, either remove the transmitters or cover them appropriately until resection has been completed.

The femoral cutting guide is fixed from the anterior side using two headless screw pins. The cutting guide can now be relocated via the available pin holes (in 2 mm steps). When the desired resection height has been set, the cutting guide is additionally fixed medially and laterally via oblique headed pins, and the resection can be performed. In this step, an adaptation of the femoral size still is possible with a long press on the right or left pedal.
21.2 Reassessing the Distal Resection

After reassessing the distal femur resection using the femur orientation guide or the 4-in-1 cutting guide with the modular RB adapter (IQ instruments), perform rotational adjustment and the A/P positioning according to the prior planning.
21. Distal Femur Resection, Control and Rotational Orientation (continued)

21.3 Setting the Rotational Alignment

Set the rotational alignment with the corresponding femur orientation guide or with the 4-in-1 cutting guide (IQ instruments). The femoral orientation guides can be aligned according to the favored value. After the desired position has been reached, the two holes for the fixation pins of the 4-in-1 cutting block are performed through the marked holes corresponding to the sizes S, M or L. The orientation guide can be removed and the 4-in-1 cutting guide can be fixed medially and laterally in the two prepared holes with the help of oblique pins. After that, the cuts can be performed in the order of anterior, posterior followed by the oblique cuts.

The 4-in-1 cutting guides with RB adapter (IQ instruments) can be fixed directly after the desired rotational position has been reached, and the cuts can be performed in the order of anterior, posterior, followed by the oblique cuts. After completing resections, implantation can now be performed, first with trial implants and then with the final implants.

TIP

The rotation value is displayed in relation to the recorded posterior condyles. At this point, both an adjustment to the palpated epicondyles (option) and a visual examination of the rotation position with respect to the Whiteside's line can be performed (information on the left).

In addition to the planned femoral size, the possible tibia implant combinations depending on the selected prosthesis system are displayed. In addition, the extension/flexion angle is displayed on the right side of the screen. In this step, an adaptation of the femoral size still is possible with a long press on the right or left pedal.
The mechanical axis achieved postoperatively (varus/valgus angle), as well as the maximum possible extension of the leg, can now be checked using trial implants and at the end using the final implant. A documented result of the operation is provided, which can be attached to the patient file if desired.

**Note:** The instrumentation and the assembly of the implants take place as described in the following surgical techniques:

- **Columbus MIOS®**  
  - DOC620
- **VEGA System®**  
  - DOC1033
- **Columbus IQ**  
  - DOC1172
23. Femur First Technique

23.1 Condyle Recording/Recording Whiteside's Line

The distal condyles are recorded with the help of the corresponding orientation block which must be in contact with the distal condyles. The alignment in the sagittal plane is displayed on the right half of the screen. The data capture should take place when the block is located in the sagittal plane perpendicular to the mechanical femur axis (i.e. the display on the screen has a slope of about 0°). The angle between the posterior condyle line and the orienting block is displayed in the middle of the screen.

Note: Please follow all steps up to and including Chapter 14.
23.2 Optimization of Anterior Cortex

After the distal and dorsal condyles have been recorded, an optimization of the anterior points on the femur with the pointer (FS604) and the respective transmitter takes place. Proceed with the pointer tip on the anterior stem in proximal or distal direction until the two value fields show the same numbers. The value field that is distal to the femur component shows the size of the femur implant in the AP direction. The value field above the femur component shows the size of the femur implant in the proximal/distal direction. The blue arrows show in what direction the pointer has to be moved in order to obtain appropriate palpation of the anterior point with respect to the A/P and the proximal-distal implant size.

Below, in the middle of the screen, there is a “running display”. Displayed is the femur size and the possible combination of tibia size for the current position of the pointer while moving the pointer proximally or distally on the femur. These combinations are based on the implant system initially selected.
23. Distal Femur Resection

Fit the distal femur resection block or the modular RB adapter of the femoral cutting guide (IQ instruments) with the corresponding passive transmitter (FS633). Determine the precise resection height in relation to the bony reference points palpated on the distal femoral condyles medially and laterally by moving the cutting guide in a proximal or distal direction. The target values are those which correspond with the distal thickness of the respective femoral implant. The size of the respective femoral implant is indicated in the upper central part of the screen. Additionally as an option, the deviation from the joint level measured during the step "condyle reference", here shown as 0 mm, is indicated.

**TIP**

In order to avoid contamination of the marker balls on the transmitters, either remove the transmitters or cover them appropriately until resection has been completed.

The femoral cutting guide is fixed from the anterior side using two headless screw pins. The cutting guide can now be relocated via the available pin holes (in 2 mm steps). When the desired resection height has been set, the cutting guide is additionally fixed medially and laterally via oblique headed pins, and the resection can be performed. In this step, an adaptation of the femoral size still is possible with a long press on the right or left pedal.
23.4 Reassessing the Distal Resection

The reassessing of the femur resection takes place with the corresponding femur orientation guide or the corresponding 4-in-1 cutting guide with modular RB adapter (IQ instruments).
23.5 Setting the Rotational Alignment

Set the rotational alignment with the corresponding femur orientation guide or with the 4-in-1 cutting guide (IQ instruments). The femoral orientation guides can be aligned according to the favored value. After the desired position has been reached, the two holes for the fixation pins of the 4-in-1 cutting block are drilled through the marked holes corresponding to the size S, M or L. The orientation guide can be removed, and the 4-in-1 cutting guide can be fixed medially and laterally in the two prepared holes with the help of oblique pins. After that, the cuts can be performed in the order of anterior, posterior followed by the oblique cuts.

The 4-in-1 cutting guides with RB adapter (IQ instruments) can be fixed directly after the desired rotational position has been reached, and the cuts can be performed in the order of anterior, posterior, followed by the oblique cuts.

TIP

The indicated rotation value is when the same rotational position as in the step "record whiteside's line" displayed in green is reached. An additional visual examination of the rotational position to Whiteside's line is possible at any time.

Note: After preparation of the femur, the procedure is continued by following the steps described in Chapters 15-16. The final display and reassessment of the postoperative mechanical leg axis is analogous to Chapter 22 of the tibia first technique.

In addition to the planned femoral size, the possible tibia implant combinations depending on the selected prosthesis system are displayed. In addition, the extension/flexion angle is displayed on the right side of the screen.

In this step, an adaptation of the femoral size still is possible with a long press on the right or left pedal.

Note: The instrumentation and the assembly of the implants take place as described in the following surgical techniques:
- Columbus® MIOS® DOC620
- VEGA System® DOC1033
- Columbus IQ DOC1172
The mechanical axis achieved postoperatively (varus/valgus angle), as well as the maximum possible extension and flexion of the leg, can now be checked using trial implants and at the end using the final implant.

A documented result of the operation is provided, which can be attached to the patient file if desired.
### 25. Instrument Set Overview OrthoPilot® TKA

**ST0298 - TKA Passive Instrument Sets Tray 1 of 2** (Used only with Columbus Instrument ST0448. OrthoPilot (FS101) must be ordered separately (ST0292))

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<thead>
<tr>
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<tbody>
<tr>
<td>A1-3</td>
<td>1 ea.</td>
<td>FS633, FS634, FS635</td>
<td>Passive Transmitter Yellow, Blue, Red</td>
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<td>B1-6</td>
<td>2 ea.</td>
<td>NP620R, NP621R, NP622R, NP623R, NP624R, 25R</td>
<td>Bicortical Screw 30 mm, 35 mm, 40 mm, 45 mm, 50 mm, 55 mm</td>
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<td>C</td>
<td>3</td>
<td>NP619R</td>
<td>Mounting Sleeve</td>
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<table>
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<th>Description</th>
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<tr>
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<td>Hex Head Adapter</td>
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<td>E</td>
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<td>NP281R</td>
<td>Screw Gauge</td>
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<td>F</td>
<td>1</td>
<td>NP615R</td>
<td>Drill 3.2 mm</td>
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<tr>
<td>G</td>
<td>1</td>
<td>NP616R</td>
<td>Drill Guide</td>
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**ST0298 - TKA Passive Instrument Sets Tray 2 of 2** (Used only with Columbus Instrument ST0448. OrthoPilot (FS101) must be ordered separately (ST0292))

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<td>1</td>
<td>NP617R</td>
<td>Check Plate</td>
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<td>NP608R</td>
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<td>NM769R</td>
<td>Foot Plate</td>
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<td>F1-2</td>
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<td>NP596R, NP597R</td>
<td>Tibial Cutting Guide Left, Right</td>
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<td>Distal Femoral Cutting Guide</td>
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## ST0006 - Columbus MIOS® Instrumentation

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<td>NQ941R</td>
<td>MIOS Tissue Protection Sleeve for Rigid Body</td>
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<td>C</td>
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<td>NQ940R</td>
<td>MIOS Handle for Tissue Protection Sleeve</td>
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<td>NQ959R</td>
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<td>NQ944R</td>
<td>Columbus MIOS Femoral Positioning Guide</td>
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<td>NQ958R</td>
<td>MIOS Y- Footplate for Alignment Guide</td>
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<td>G</td>
<td>1</td>
<td>NQ957R</td>
<td>MIOS Footplate Right for Alignment Guide</td>
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<td>H</td>
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<td>NQ956R</td>
<td>MIOS Footplate Left for Alignment Guide</td>
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<td>MIOS Tibial Cutting Block Left Medial</td>
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<td>J</td>
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<td>NQ952R</td>
<td>MIOS Tibial Cutting Block Right Medial</td>
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<td>K</td>
<td>1</td>
<td>NQ953R</td>
<td>MIOS Distal Femoral Cutting Block</td>
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<td>NQ954R</td>
<td>Columbus MIOS Femoral Alignment Guide</td>
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<td>NQ941R</td>
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<td>U</td>
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<td>NQ944R</td>
<td>MIOS Femoral Positioning Guide</td>
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**ST0477 – Navigation Instrument Set** *(To be used in conjunction with ST0298 – TKA Passive Instrument Set and ST0392 – OrthoPilot)*

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<tbody>
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<td>IQ Navigated Femoral Alignment Block</td>
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<td>B</td>
<td>1</td>
<td>NQ958R</td>
<td>MIOS Y-Footplate Femoral Alignment Block</td>
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<tr>
<td>C</td>
<td>1</td>
<td>FS626R</td>
<td>IQ OrthoPilot TKA RB-Adapter Modular</td>
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**NOTE:** ST0477 does not include passive instruments. Order ST0298 for passive instruments

<table>
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<td>NP609R</td>
<td>Femorotibial Gap Distractor for NP604R</td>
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<tr>
<td>E</td>
<td>1</td>
<td>NP604R</td>
<td>Femorotibial Gap Measuring Gauge (3 pcs.)</td>
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<td>1</td>
<td>NP637R</td>
<td>IQ VEGA PS Tray Complete Set Navigation Instrument</td>
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<td>1</td>
<td>JH217R</td>
<td>1/1 Size Wide Perforated Basket Lid 488 x 257 mm</td>
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# OrthoPilot®

OrthoPilot KneeSuite™ – TKA 5.1  
Total Knee Arthroplasty, Columbus®, VEGA System®, Columbus IQ

## 26. Software and Consumeables

### 26.1 Software OrthoPilot® TKA FS235

<table>
<thead>
<tr>
<th>Software Module</th>
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<td>OrthoPilot TKA</td>
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### 26.2 Disposable Passive Marker Spheres

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<thead>
<tr>
<th>Marker spheres</th>
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<tr>
<td>NDI single-use passive markers (3 x 4 pcs.)</td>
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<tr>
<td>CAP single-use passive markers (3 x 4 pcs.)</td>
<td>FS618SU</td>
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</table>
27. Schematic Program Flow TKA

27.1 Schematic Program Flow – Tibia First

- Input patient data
- Selection operating field and instrument
- Registration medial condyle, dorsal
- Registration lateral condyle, dorsal
- Registration anterior cortical point
- Medial tibia reference
- Lateral tibia reference
- Tibia center registration
- Registration medial malleolus
- Registration lateral malleolus
- Registration anterior ankle joint point
- Hip center registration
- Regular
- Optional
- Knee center registration (start screen)
- Knee center registration
- Registration mechanical axis
- Planning of tibia cut
OrthoPilot®
OrthoPilot KneeSuite™ – TKA 5.1
Total Knee Arthroplasty, Columbus®️, VEGA System®, Columbus IQ

27. Schematic Program Flow TKA (continued)

27.2 Schematic Program Flow – Femur First

- Input patient data
- Selection operating field and instrument
- Registration medial condyle, dorsal
- Registration lateral condyle, dorsal
- Registration anterior cortical point
- Medial tibia reference
- Lateral tibia reference
- Tibia center registration
- Registration medial malleolus

- Registration tibia cut
- Registration distal and posterior condyles (condyle reference)
- Optimization anterior cortex
- Registration joint gap in extension
- Registration joint gap in flexion
- Femoral planning
- Planning distal femur cut
- Registration femoral cut
- Setting 4-in-1 femoral cutting guide
- Mechanical axis post-OP
27. Schematic Program Flow TKA (continued)

27.2 Schematic Program Flow – Femur First (continued)

- Registration lateral malleolus
- Registration anterior ankle joint point
- Hip center registration

Regular

Optional

- Knee center registration (start screen)
- Knee center registration
- Registration mechanical axis
- Condyle reference/record Whiteside's line

- Optimization anterior cortex
- Planning distal femur cut
- Registration femoral cut
- Setting 4-in-1 femoral cutting guide
- Planning of tibia cut
- Registration tibia cut
- Mechanical axis post-OP
OrthoPilot®
OrthoPilot KneeSuite™ - TKA 5.1
Total Knee Arthroplasty, Columbus®, VEGA System®, Columbus IQ