Knee surgery with a navigation system

The OrthoPilot® navigation system makes perfect implantation of artificial knee joints possible.

What is OrthoPilot®?

OrthoPilot® is a computer assisted navigation system which helps the doctor to perform operations on the knee joint with accuracy and with equally good results for all patients. OrthoPilot® was developed by the Technical University in Grenoble, France, in cooperation with Aesculap and with initial funding from the European Union.

In contrast to a surgical robot, OrthoPilot® is a pure navigation system, similar to that in a car. This means that it shows the surgeon where the mechanical axis of the leg is situated. This axis is very important for the success of the operation.

The information given by OrthoPilot® helps the doctor to achieve the best possible position for the implant in accordance with his or her planning. The doctor maintains control over the implantation procedure throughout the operation, and can proceed manually at any time should this become necessary.

The navigation of orthopaedic operations is a mature technology. OrthoPilot® has already been used successfully in over 6,000 knee implantations and is standard in many hospitals.
What benefits does OrthoPilot® bring?

One important precondition for a good result in joint replacement is the correct geometric alignment of the implant components to the mechanical leg axis. This axis is a straight line which runs from the midpoint of the ball of the hip to the midpoint of the ankle. If the centre of the knee does not lie on this axis, this is known as knock knees or bow legs.

To avoid this deviation, and the undesirable wear and tear on the prosthesis it causes, the damaged joint surfaces of both the upper and lower leg bones must be prepared with millimetre precision, and the implant components must be inserted in exact alignment. An even loading on the knee prosthesis is achieved by positioning the cuts in the bone in precisely the right relation to the mechanical leg axis. The OrthoPilot® navigation system helps the surgeon to align the implant components accurately and increases the stability of the knee through adapting the implant to the ligamentary tension in the knee joint.

In contrast to many other systems, the OrthoPilot® navigation system does not require the patient to undergo any additional preoperative examinations. Additional radiation exposure from x-rays or CT scans is completely unnecessary with OrthoPilot®. The advantages for the patient are obvious. The accuracy of this new method in aligning the implant creates the precondition for long life for the artificial knee joint and good leg function. Knock knees or bow legs are corrected. And this with no extra radiation exposure.
How does OrthoPilot® work?
Various different components work together in OrthoPilot® to make navigation of the instruments possible. We would like to introduce and explain these briefly below:

1. Infrared camera
The camera uses infrared light to establish the position of the transmitters and the mobile palpation instruments. Infrared light is not dangerous to health and is also used as a form of treatment in other areas.

2. Transmitters
Transmitters are fixed to the instrumentation and send infrared light to the camera, from which the positional data are calculated.

3. Mobile palpation instrument
The mobile palpation instrument reflects infrared light emitted by the camera, and from this the positional data are calculated.

4. Screen
The screen displays the axes and other data.

5. Cart
This contains the computer, keyboard and mouse.

OrthoPilot® is a unit comprising a computer with keyboard and mouse, a screen, a camera and transmitters. On this basic unit the software for calculating the navigation is used, and it is possible to use different software applications for different operations. During the operation the position of the instrumentation is continuously displayed via the transmitters attached to the instruments and to the pelvis. From the different positions of the transmitters, the software is able to calculate a three dimensional image. The first step is to measure the pelvis and calculate the anatomical axes. The screen shows the surgeon the position of the instrumentation in relation to the calculated axes. This permits accurate positioning of the artificial knee joint.
The surgical procedure with OrthoPilot®

1. An incision approx. 15 cm in length is made in the skin and the muscles and knee cap are moved aside to expose the knee joint.

2. Transmitters are fixed onto the foot, thigh and lower leg.

3. The midpoints of the hip, knee and ankle are calculated by moving the leg. The ideal load bearing axis runs through these points. The OrthoPilot® camera records the movements of the transmitters.

4. To achieve the optimum implant surface for the prosthesis components, the upper and lower leg bones are prepared with a saw at right angles to the leg axis.

5. The screen shows the doctor the exact position of the cutting templates and when these are in the right position and at the correct angle.

6. Once the optimum implant bed has been created, the knee prosthesis is implanted in correct axial alignment. The doctor can check the result of the implantation again by referring to the leg axis.