Navigated Implantation of the *Columbus* Total Knee Arthroplasty with the OrthoPilot System: Version 4.0

F. Lampe, E. Hille

Authors' Experience with the OrthoPilot Navigation System in Total Knee Arthroplasty

We started the OrthoPilot-assisted implantation of the Search Evolution knee endoprosthesis (Aesculap, Tuttingen, Germany), which was the implant available for use with navigation at the time, in our hospital in June 1999 [1]. Stulberg, Saragaglia and Miehlke have already described the OrthoPilot navigation system in detail in various chapters in this volume, and reported on the good prosthesis alignment they were able to achieve. In our own patients we have compared the radiological results in 110 cases. 55 patients were treated with navigated Search Evolution knee replacements and 55 with conventionally implanted Press Fit Condylar (PFC) knee endoprostheses (DePuy, a Johnson & Johnson Company). It should be borne in mind that the navigated cases constituted our first patient series, and were therefore affected by the learning curve, whereas for conventional implantation of the PFC system we already had years of experience in our hospital to draw on. In spite of this, looking at the so-called alignment index, which makes it possible to consider as a whole the five relevant parameters for evaluating prosthesis alignment - the mechanical leg axis and the four femoral and tibial component angles in the anterior and the sagittal plane - we could already record significantly better results in the navigated group, even though the differences compared with the conventionally treated patients in our series were not quite so pronounced as in other comparable studies (Table 35-1) [2, 3].

Based on our positive experiences with the OrthoPilot system, we started navigated implantation of the new Columbus knee endoprosthesis (Aesculap, Tuttingen, Germany) in December 2002. This implant has a convincing concept and design and in our opinion satisfies all the criteria of a modern surface replacement. Furthermore, the new Version 4.0 of the OrthoPilot system promises adequate support in balancing the soft tissues in order to achieve congruent and symmetrical gaps, so that the combination of the Columbus knee with the OrthoPilot navigation system appears very promising.

Concept and Design of the Columbus Knee Endoprosthesis

The foundations for the design of surface knee replacements were laid in the 1970s. The experiences gathered in the subsequent decades led to growing convergence in the requirements concerning implant design. Today, new developments have to be orientated towards and assessed according to these requirements. For this reason we should first give a short summary explaining some particular aspects of the Columbus design concept which have persuaded us to introduce this implant as first users in our hospital (Fig 35-1).
The implant geometry guarantees the greatest possible femorotibial congruence in the frontal and sagittal plane to maximize the contact surfaces and minimize contact stresses. This reduces polyethylene wear and improves the intrinsic stability of the implant.

The anteroposterior and mediolateral geometry of the femoral components has been optimized. There are 7 femoral sizes and 5 tibial sizes (of which sizes 1-4 each have an additional plus variation with a larger sagittal diameter) available. Femoral and tibial components of all dimensions can be combined with each other freely. This means that optimum consideration can be taken of the individual anatomical and biomechanical conditions.

The femoral geometry has a deepened and retropositioned trochlea in the kinematically favorable 7° position. This improves femoropatellar congruence and kinematics, which has a positive influence on flexion ability and polyethylene wear after patellar resurfacing.

The radius and length of the posterior condyles in the sagittal plane have been reduced, improving the intrinsic flexion ability of the implant.

Polyethylene components with a 3° posterior slope are available in posterior cruciate ligament retaining (PR) versions. Furthermore cruciate ligament substituting (PS), »rotating platform« (RP) and »deep dish« versions are provided. The components have modular heights up to 20 mm.

The conventional instrumentation is highly advanced. The possibility of navigation with the new OrthoPilot Version 4.0 exists as an alternative.