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EXPERIENCES WITH THE "CASPAR" ROBOT FOR TOTAL KNEE ARTHROPLASTIE

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INTRODUCTION:

When searching the literature, it is notable that several studies show a high revision rate and a sub-optimal outcome of up to 40% in TKA which seems to be mainly due to malalignment. Therefore it can be concluded that the probability of survival of a bicondylar knee prosthesis is highly dependant on the intraoperatively achieved alignment of the components. Although implantation instruments assist the surgeon, the alignment depends essentially on the surgeon's experience. Our goal was to reconstruct the mechanical axis of the leg and to achieve a correct joint line with balanced ligaments by improving preoperative surgical planning and intraoperative precision. In experimental investigations the reliability and safety of the CASPAR-System (ortoMaquet, Rastatt/Germany) were tested on artificial and human bone in the Dept. of Anatomy. After extensive testing and standardization of the procedure, the first clinical TKA was performed with assistance of the CASPAR-System on March 27, 2000 in the Kassel Orthopedic Center in Kassel, Germany.

TECHNIQUE:

As orientation for the robot bicortical screws with a special thread are inserted as fiducial markers one in each bone, femur and tibia, in a way that the stab-incision lies within the scar of the final operation. The skin is closed as to be free to plan a one or two day procedure.

A CT of the affected leg is taken. These x-rays allow a precise 3D planning of the cutting planes and positioning of the prosthetic components with regard to the mechanical axis in the frontal and sagittal planes as well as the joint line (classical or anatomical), the dorsal slope and the rotation of each component.

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The data of the planning station are transferred to the robot, who carries out the milling as planned with a theoretical accuracy of 0.03 mm. The cutting planes are very smooth and exact so that the prosthesis fits perfectly. Undesired bone-motion during the milling procedure is constantly detected by a Polaris camera system. Apart from the milling process and the postioning of the leg in a special fixation device, the operation is performed in the traditional technique.

RESULTS:

Up to January 2001 we performed robotic TKA on 62 patients and 61 knees (one patient was operated on both knees in a single procedure) with good clinical results. There were a few minor technical problems especially in the beginning without affect to the patient. Peri- and postoperative complications were similar to the compared group of 335 patients, who had manual TKR during the same period except for nerve damages, which were not seen in the robot assisted group. Alignment was significantly better using the CASPAR-System being within the optimal range of 0°- 3°.

CONCLUSION:

This new technique is an advantage to manual implanted TKA as the planning and the implementation are so precise that the tibiofemoral alignment achieved in our patients had an overall mean difference to the preoperative plan of only 0,8°. Thus we expect less implant loosening especially of non-cemented knee prostheses. There were no major complications due to this new system which means safety for the patient. All data are collected in a prospective study to prove the safety, accuracy and feasibility of the CASPAR-System. In the long run, different types of prostheses may need to be developed in order to meet up to the accuracy of the robotic system.