INTRODUCTION:
Within the past ten years computer assisted surgery has been introduced for total hip replacement (THR), especially for cup navigation [1]. The aim is an even more precise placement of the prosthesis. Nevertheless hip navigation is still a new surgical method not established generally yet. Total hip arthroplasty, performed for secondary coxarthrosis after congenital dysplasia of the hip, has a higher incidence of complications than for primary degenerative arthritis [2]. Therefore it makes sense to use this new technique at patients with such difficult anatomical situation and to navigate both socket and the femoral stem. The value of combined cup and stem navigation should be investigated in comparison with the conventional surgical technique.

METHODS:

With the hypothesis that computer-assisted planning and navigation of the THA would be more accurate and yield better clinical results we started with acceptance from the ethic committee of our University and after having obtained informed consent a controlled prospective randomized study comparing CT-free, imageless navigation (group 1) with the conventional surgical technique of THA (group 2).

**Navigation Group (Group 1)**
37 patients were randomly assigned to: computer-assisted planning and biomechanical evaluation of the hip geometry with determination of the optimal THA position using planning software MediCAD [3]; imageless cup and stem navigation (10 THA with Duraloc press-fit cup and Vision 2000 stem implanted with Vector Vision navigation (Brainlab, Germany), 27 THA with Allofit press-fit cups and CSL stem with Navitrack navigation (OrthoSoft, Canada); supine position of the patient; lateral translgluteal approach. All operations were performed by two experienced surgeons. During navigation we used a new nomogram of tilt adjusted cup angles of inclination and anteversion in order to obtain an individual optimal, safe cup alignment [4].

**Control Group (Group 2)**
37 patients were randomly assigned to: conventional planning of THA using templates; conventional “free-hand” surgical technique; supine position of the patient; lateral translgluteal approach. All operations were performed by three experienced surgeons using the same implants as in the navigation group.

At 6–8 months after surgery detailed evaluation of the clinical results was performed. Postoperative CT scans of the pelvis were loaded into the navigation workstation. Using the CT-based navigation software and radiological definition of the cup angle, the cup position and pelvic tilt in supine position were measured. Furthermore we analysed the postoperative leg length differences.

The Harris hip score (HHS) (max.100 points) and the Merle d’Aubigne and Postel score (MPS) (max.18 points) were used to evaluate the clinical results. This outcome assessment was accompanied by measures of general health-related quality of life (36-item Short-Form Health Survey, SF-36) and of disease-specific health (WOMAC score). Statistical analysis was performed with SPSS software using Student’s t-test or the Mann-Whitney U-test after testing the distribution of the data by means of the Shapiro-Wilk test. Values of p<0.05 were regarded as significant.

RESULTS SECTION:

Despite difficult anatomical conditions the navigation of the socket and the femoral stems was feasible in all cases. The postoperative analyses showed a significantly better realization of the biomechanically optimal position of the prosthesis planned in MediCAD in group 1. The CT measurements of deviation from optimal cup position showed a wider distribution of cup angles in group 2 than in the navigated cups in group 1 (Fig.1). We found less “outliers” regarding the optimal inclination and anteversion of the socket component.

The differences between planned and achieved leg lengthening are also smaller in the navigation group. The HHS (95 versus 84 points) and MPS (17 versus 14 points) indicated a significantly better outcome of the patients after navigated THR; however, the SF-36 and the WOMAC score showed no statistically relevant differences between the two groups.

DISCUSSION:
The combined navigation of socket and shaft is possible also at dysplastic deformities of the acetabulum with a high precision. Compared with the conventional “free hand” surgical technique the navigation can due to a perfect translation of the preoperative planning into the operative procedures, a more exact orientation of the implant angles and the considerably better compensation of leg length differences be judged particularly positively. With navigation of both components trial reduction of the prosthesis is not necessary. Despite some disadvantages such as costs and increased operating time (10-15 minutes) the advantages of planning and high precision of component placement including reconstruction of leg length are obvious. Whether with this technique an impingement and wear between the liner and the stem of the prosthesis can be avoided and whether better long time results of THR can be achieved have to be checked in further studies. In the future a practical, simple technique must be developed for application of imageless hip navigation with the patient also in the lateral position, which is required for the posterior surgical approach and other minimal invasive approaches.

REFERENCES:

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