Introduction

Opponents to CT-guided navigation of acetabulum components in total hip arthroplasty (THA) argue that this technique is not problem oriented, time consuming with additional radiation, and too inconvenient for practical routine use. Therefore, two- and three-dimensional fluoroscopic systems have been developed as well as purely kinematics based systems, such as the OrthoPilot (Aesculap, Tuttingen, Germany).

Having gained considerable experience in the field of CT guided hip acetabulum navigation in two controlled comparative trials with 150 CT cases, we now extended the indication to perform SurgiGATE CT navigation on dysplastic and revision THA as well. There were 20 dysplastic hips that entered the second study, in which the alignment of the acetabular cup was confirmed by CT scan. Revision cases had preoperative CT scans. Due to considerable artifacts caused by the metal cups, we recommend CT scans in loosened cemented polyethylene cups only, however, even metal head makes interpretation and planning difficult (see Fig. 12-2).

Cup Navigation in Dysplastic Hip Joints

CT-based planning of cup alignment in dysplastic hips offers the advantage of exact calculation and prediction of component positioning with regards to the hip center. Both 2D fluoroscopy and fully kinematics based system software are not able to accomplish these goals. Dysplastic hips are usually combined with pathologic femoral shaft versions, which require implant adaptation in terms of a deviation from the norm. This technique has been established using the conventional technique and individually increases range of motion. A variety of implant products is needed (screwed cups, press-fit cups, etc.), therefore, open navigation systems become a necessity with a "library" that allow for different manufactures implants.

Case Report 1

This case demonstrates a secondary dysplastic hip OA 20 years after Chiari osteotomy. The opposite side was treated conventionally 4 years ago using a Burch-Schneider cage and autologous bulk bone grafting with 5 cm leg lengthening (Fig. 12-1). A screw in cup plus autologous bone grafting was planned for navigation of the remaining dysplastic hip. Preoperative radiographs included artifacts from the metal implants, which led to software and cup positioning problems in comparison to the medCAD system (Fig. 12-2). However, cup size and cranial acetabular reconstruction could be planned (Fig. 12-3).

Since the acetabular congruency was pathological, the antversion angle was changed from an ideal 25 degrees to 15 degrees with 45 degrees inclination. The hip center was calculated from the opposite side radiographs, because of the missing tear drop structure (Fig. 12-4). Required anatomical landmarks were non-existing in this case, therefore, intraoperative pair-point matching as described in chapter II is impossible. Preoperative planning and surgical execution should be performed by the same person (Fig. 12-5). Intraoperative navigation necessitates both two-plane orientation and perfect acetabular positioning. Preoperative planning and postoperative results show excellent correlation (Fig. 12-6).
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The surgeon can check upon the accuracy of the navigation system throughout the operation. The implantation of an acetabular 2.7 mm temporary reference screw, which carries a reproducible pointer housing has proven to be useful.

**Case Report 2**

The challenge in this case was complicated by high hip dislocation with 5 cm limb shortening of the right side with a normal opposite hip joint (Fig. 12-7). Soft tissue attachment would not allow full leg length restoration, but preoperative expander treatment was refused. According to the literature medium term Harris Hip Score results were comparable with the hip center located either in the primary, secondary or tear-drop position.

The goal was to use a press-fit implant (ECM-Cup, Stratec), which allows fixation of bulk autograft via component implemented screw holes. In order to accomplish vertical screw positioning the cup had to be put into 45 to 50 degrees of inclination and 15 degrees of anteverision. Preoperative planning led to a less than ideal hip center and decreased anteverision compared with the opposite side because of pathological shaft position (Fig. 12-8).

Although resorption of autologous bulk bone grafts remains an issue of concern, some authors accept cup inclinations of up to 50 degrees in order to improve host bone contact with the cup [5, 8]. Considerable autograft resorption in seven (9%) of 77 cases was reported in one series [6]. Whether or not bulk graft requires screw fixation is controversial.

Although CT data indicated dysplastic anterior and posterior columns, a satisfactory positioning of the cup could be achieved intraoperatively, a difficult maneuver when performed by conventional methods (Fig. 12-9 a,b). One of the main advantages of 3D preoperative planning is the possibility of predictive cup positioning despite massive bone defects and acceptable compromises (Figs. 12-10 and 12-11).

In the remaining 18 cases the final cup positioning was within 2 mm of tolerance compared with preoperative planning, a figure that is likely to improve with a more precise preoperative planning. In some cases a perforation of the caudal acetabular floor with a cage was