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Acetabular Component Positioning in Total Hip Arthroplasty With and Without a Computer-Assisted System: A Prospective, Randomized and Controlled Study

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ABSTRACT

In a study of the acetabular component in total hip arthroplasty, 20 hips were operated on using imageless navigation and 20 hips were operated on using the conventional method. The correct position of the acetabular component was evaluated with computed tomography, measuring the operative anteversion and the operative inclination and determining the cases inside Lewinnek's safe zone. The results were similar in all the analyses: a mean anteversion of 17.4° in the navigated group and 14.5° in the control group ($P = .215$); a mean inclination of 41.7° and 42.2° ($P = .633$); a mean deviation from the desired anteversion (15°) of 5.5° and 6.6° ($P = .429$); a mean deviation from the desired inclination of 3° and 3.2° ($P = .783$); and location inside the safe zone of 90% and 80% ($P = .661$). The acetabular component position's tomography analyses were similar whether using the imageless navigation or performing it conventionally.

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Total hip arthroplasty (THA) is considered to be one of the most successful orthopedic interventions [1,2]. The position of the acetabular component is critical to the function and outcome of THA by improving longevity and decreasing the dislocation rate [3,4].

The acetabular component is positioned based on the surgeon's experience and on the mechanical alignment guides, which are limited by the assumption (many times mistaken) that the patient's trunk and pelvis are aligned in a correct and known orientation to the operation table and remain so throughout the whole course of the procedure [5–7].

Intraoperative surgical navigation (computer-assisted surgery) dates back to the 1970s, while adaptation to orthopedic procedures took place in the mid-1990s, being introduced in THA in 1998 [5,8]. The doubts that persist about navigation in general are its real benefit, its cost, the longer surgical time and the potential complications.

The most accurate method to determine the acetabular component position is computed tomography (CT). High-quality prospective and randomized reports of postoperative CT evaluation have been published, comparing the navigated technique with the conventional one, performed with the patients being operated on in the supine position [7,9,10]. There is, however, a lack in the literature of good-quality articles with the same methodology that evaluate patients operated on in the lateral position.

Our objective is to evaluate with postoperative CT the position of the acetabular component in THA, comparing the navigated image-free technique with the conventional technique, performed with the patients in lateral decubitus.

Materials and Methods

We studied, prospectively, 40 hips with the indication of primary THA, between September 2008 and April 2010.

The inclusion criteria were as follows: presence of hip primary ostheoarthritis or femoral head osteonecrosis and an indication of THA; age between 20 and 80 years old; body mass index (BMI) less than 35 kg/m^2; and having signed the Free and Explained Consentment Terms from our institution.

The exclusion criteria were as follows: patients refusal at any time during the research; presence of any serious illness that would make surgery impossible; presence of an altered pelvic anatomy, as in cases of dysplasia; presence of any previous orthopedic surgery, excluding the contralateral THA; and patient death.

We adopted the randomization criteria used by Excel for Windows 2007. We then obtained a list of 40 numbers divided into 2 groups of 20 patients, labeled navigation and control.

Regarding the surgical technique, the patients in both groups were positioned in lateral decubitus and were strongly fixed to the surgical table. All surgeries were performed by the same surgeon (HMCG) using a modified approach by Hardinge [11]. In the control group the surgeon used his experience and a mechanical alignment guide to implant the acetabular cup.

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The same prostheses were implanted in all patients: a noncemented femoral stem (Bicontact, Aesculap, B. Braun, Tuttlingen, Germany), a noncemented acetabular cup (Plasmacup, Aesculap), a polyethylene liner and a 28-mm metallic head.

The navigation system used in the navigation group was the Orthopilot (Aesculap, B. Braun, Tuttlingen, Germany) with the THAplus software. The system required the placement of a tracker screw in the iliac crest. The anterior pelvic plane (APP) was determined by percutaneous palpation of the anterior superior iliac spines and of the pubic symphysis with a special palpation device, which was registered with the computer.

The postoperative CT scans were all performed at our radiology institute. The equipment was the Philips Brilliance CT 64-channel scanner (multislice technique), with a 32 × 1.25-mm collimaton, pitch of 0.656, tube rotation of 0.75 s, 400 mm FOV, 512 matrix, and radiation dose CTDIvol of 32.91 mGy or DLP of 1304.96 mGy-cm. The images were stored in the DICOM format and then sent to the workstation iSiteRadiology 4.1.101.0, Philips, where they were manipulated.

The images were reconstructed, taking as a reference the anterior pelvic plane APP, assumed to be the coronal plane. The sagittal and axial planes were determined as those perpendicular to the APP (Fig. 1). Following the orientations of Murray[12], the operative

Fig. 1. Tomographic anterior pelvic plane (APP), assumed to be the coronal plane (superior image). Axial plane (inferior right), perpendicular to the APP. Sagittal plane (inferior left), perpendicular to both coronal and axial planes. In the sagittal plane, the coronal plane (APP) is represented by the blue line, and the axial plane is represented by the green line.