GOOD VS. POOR RESULTS AFTER TOTAL HIP ARTHROPLASTY: A COMPARISON OF IMPLANT AND ANATOMICAL PARAMETERS

Samy Bendaya MD PhD[1,2]*, Carolyn Anglin PhD[3], Jean-Yves Lazennec MD PhD[4], Rachele Allena PhD[1], Philippe Thoumie MD PhD[2], Wafa Skalli PhD[1]

[1,2,]* Arts et Métiers ParisTech, Paris, 75013, France and Hôpital Rothschild, Paris, 75012, France, samy.bendaya@rth.aphp.fr
[3] University of Calgary, Calgary, T2N 1N4, Canada
[4] Hôpital Pitié Salpêtrière, Paris, 75013, France

INTRODUCTION

Despite the normal success of total hip arthroplasty (THA), many patients experience postoperative issues, such as hip dislocation, leg length discrepancy, pain and muscle weakness. Given the large and increasing number of hip arthroplasties, it is important to understand the cause of these mechanical complications and the origin of hip dysfunction.

Component placement, including acetabular cup orientation and depth, together with the individual's functional posture, play key roles (Callanan 2011; Akbari-Shandiz 2014). The challenge is how to measure these. X-rays lack accuracy (Lembeck 2005) and CT scans increase radiation dose (Deschênes 2010). A newer imaging modality, EOS^{TM}, acquires low-dose, simultaneous, perpendicular anteroposterior and lateral views while providing a global view of the patient in a functional standing or sitting position, leading to a three-dimensional (3D) reconstruction for parameter calculation.

The purpose of the present study was to develop an approach using the EOS system to compare patients with good versus poor results after THA and to report our preliminary experiences using this technique.

MATERIALS AND METHODS

A total of 35 patients were studied: 17 with good results after THA (G-THA), 18 with poor results (P-THA)(Table 1). The patients were operated on or referred for follow-up to a single expert surgeon (JYL), between 2001 and 2011, with a minimum follow-up of at least two years. Good results were defined by a Harris Hip Score (HHS)>80, the patient satisfied with the surgery, without hip pain, and with a good functional result. Poor results were defined by HHS<80 or a patient presenting with postoperative pain or hip-related dissatisfaction, namely: leg length discrepancy, dislocation, pain, hip flexion contracture, lateral pelvic tilt when sitting, impingement, high metal ion counts, pelvic rotation or muscle weakness, but not infection.

Table 1: Subject details for the study groups.

	Good Results (G-THA) Mean±SD (range) (n=17)	**Poor Results (P-THA) Mean±SD (range) (n=18)**	**p-value Good vs Poor**
Male / Female	**8F / 9M**	**15F / 3M**	**0.005***
Age at review (yrs)	**67.6**±8.4 (48-77)	**65.8**±11.9 (35-83)	0.89
BMI (kg/m^2)	**26.8**±1.8 (24-30)	**27.8**±2.3 (24-31)	0.37
Harris Hip Score	**91.4**±5.6 (80-96)	**81.2**±8.1 (65 to 93)	**0.001***
Surgical Approach	**17** anterior	**8** ant/**7** post/**11** unk. (referral)	---

All subjects were imaged after THA in the standing position using the EOS system (Fig. 1); all but 2 were also imaged in the sitting position. Clinical parameters were derived from the 3D parameterized model. An ellipse was fit to the two views simultaneously to define acetabular cup inclination and version (Journé 2012) with two measurements averaged. Clinically-relevant pelvic and femoral parameters were also studied (Bendaya 2015; Lazennec 2007; Lazennec 2004).

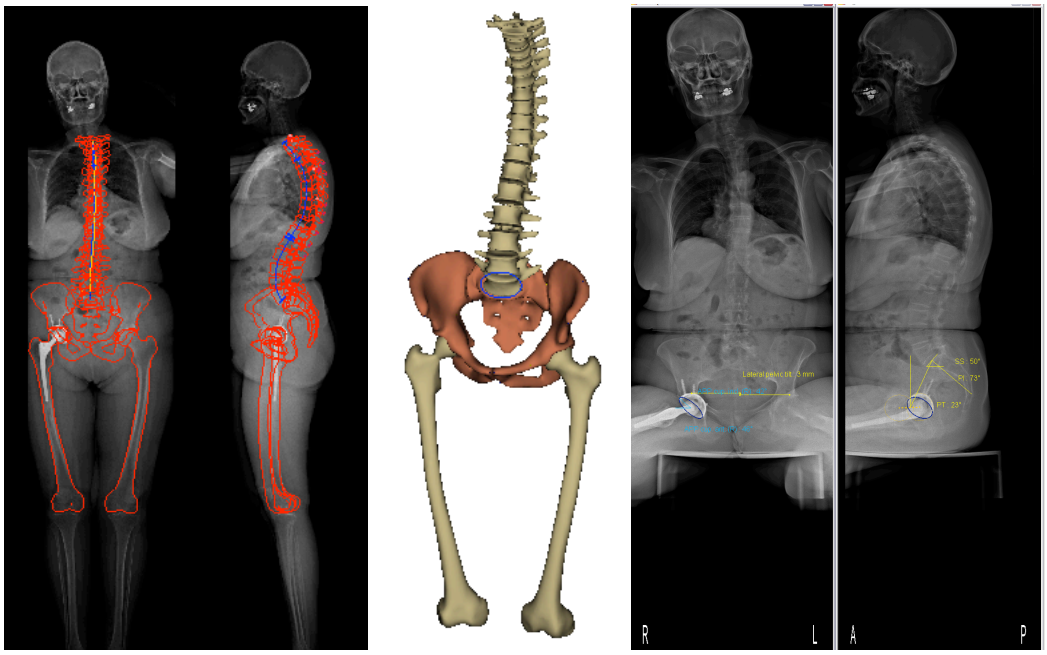

Fig. 1a Fig. 1b Fig. 1c

Fig. 1: The same patient in (a) standing position, and (b) after 3D skeletal reconstruction; (c) acetabular reconstruction in the sitting position.

Good vs. poor values and proportions were compared using a Student's unpaired t-test and chi-squared test ($p<0.05$), respectively. While multiple comparisons may over-predict significant differences, the purpose of this pilot study was to identify hypotheses for further study, and to provide an initial database of normative values. High/low values were highlighted for those individuals with parameter values more than one standard deviation from the mean of this group.

RESULTS

Age and BMI were not significantly different between groups (Table 1). HHS was significantly higher in G-THA (mean, 91) vs. P-THA (mean, 81) ($p=0.001$), as expected. The proportion of females in P-THA (15/18 or 83%) was significantly higher than in G_THA (8/17 or 47%).

Acetabular cup orientation differed significantly between groups. Acetabular version relative to the coronal plane was lower in P-THA (32º±12º) compared to G-THA (40º±9º) ($p=0.02$). Furthermore, there was a strong trend towards acetabular cup inclination relative to the APP being higher in P-THA (45º±9º, compared to 39º±7º; $p=0.07$). Proportions of P-THA vs. G-THA patients with cup orientation values higher or lower than 1 SD from the overall mean differed significantly and substantially between groups: 39% vs. 18% with higher inclination relative to the perpendicular-APP ($p<0.001$); 67% vs. 29% with higher inclination relative to the transverse imaging plane ($p<0.001$) and 50% vs. 18% with higher or lower acetabular version relative to the APP ($p<0.001$). The means of the two groups on any of the individual parameters were indistinguishable ($p=0.2$ to 0.9) (Bendaya 2015), with large variations seen

in both groups, but individuals in P-THA demonstrated a greater number of high or low parameters (3.5±1.8 high/low values, range 0-7) compared to G-THA (2.3±1.8, range 0-6). All revision cases had a least four values outside 1 SD, including acetabular cup orientation, sagittal pelvic tilt, sacral slope, femoral offset and neck-shaft angle.

Between standing and sitting, sacral slope, sagittal pelvic tilt, APP inclination, and acetabular cup inclination and version relative to the patient plane, all differed significantly in both groups ($p<0.01$).

DISCUSSION

This study investigated patients with good versus poor results after THA. It is the first to provide acetabular, pelvic and femoral parameters for these two groups (Bendaya 2015) and the first to provide evidence that a collection of high/low parameters may together contribute to a poor result. The results show the importance of acetabular component placement, in both inclination and version and the importance of looking at individuals, not just groups, to identify potential causes for pain and functional issues. In each poor-results case, we were able to identify the likely cause of the problem based on the high/low parameters.

Surprisingly, version values farther from the widely-quoted 'safe zone' (15±10°) (Lewinnek 1978) were associated with G-THA. The most likely factor is that the anterior surgical approach and the bipolar prosthesis design, used for most of these patients, have much reduced problems with dislocation, and therefore the desired orientation may be different; other factors may relate to the particular surgeon's technique.

The main limitations of this pilot study were the low number of subjects, diversity of clinical problems, and patients from a single surgeon.

In summary, acetabular cup differences do exist between the good and poor-results groups whereas most other parameters overlap so that each patient needs to be studied individually. A collection of unusual parameters appears to contribute to a poor result even when a single parameter does not. With the EOS system, a large cohort of individuals can be studied in the functional position relatively quickly and at low dose. This could lead to patient-specific guidelines for THA planning and execution.

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DISCLOSURES

The authors have no conflicts of interest.