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Case report

Ceramic-on-ceramic total hip arthroplasty: Is squeaking related to an inaccurate three-dimensional hip anatomy reconstruction?



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ABSTRACT

Many factors were incriminated in the squeaking generation in ceramic-on-ceramic total hip arthroplasty (THA), including the cup positioning and design. However, the influence of the stem orientation has not been investigated and the true three-dimensional hip anatomy has never been compared to the contralateral healthy hip. Three patients, who underwent unilateral ceramic-on-ceramic THA, complained of squeaking. CT-scans were performed to compare the true three-dimensional hip anatomy to the contralateral healthy hip. All patients presented evidence of posterior neck-rim impingement with a two-fold increase in the global anteversion (above 75°) comparatively to the healthy hip. The excess of anteversion was on the cup side in 2 cases and on the stem side in 1 case. We conclude that squeaking in ceramic-on-ceramic THA could be related to a poor accuracy of 3D hip anatomy reconstruction which generated a posterior impingement and subsequent anterior edge loading because of excessive global anteversion.

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1. Introduction

There is a rising concern about squeaking in ceramic-on-ceramic total hip arthroplasty, with an incidence ranging from 0.5% to 20% [1–4]. Many factors have been incriminated such as edge loading, ceramic fracture, third body particles [1] and components malposition. Walter et al. [2] reported that 65% of squeaking patients were not in a safe range of 25° ± 10° cup anteversion and 45° ± 10° cup inclination. Conversely, other authors [3,4] found no major cup malpositioning in squeaking patients. However, at the time of revision, all their squeaking patients showed evidence of posterior neck-cup impingement, suggesting components malposition.

All these authors used a so-called safe zone for component positioning with an optimal goal of 45° cup inclination and 15° cup anteversion [5]. However, the natural acetabular and femoral anteversion angles in primary osteoarthritis had a wide range of variation, (0 to 50°) [6] suggesting that a 15° cup anteversion may be too low or contrarily excessive, depending on the patient hip anatomy before surgery. Therefore, despite the fact that a patient is within this safe zone, impingement may occur because the patient 3D anatomy is not restored. This hypothesis is suggested by many reported studies [7–10] which showed that the impingement

risk was minimal when the components were implanted with the same anteversion angles than the natural values. We analyzed the three-dimensional hip anatomy in three squeaking patients, who underwent unilateral THA, in order to compare the replaced hip to the contralateral healthy hip.

2. Cases report

Three patients (2 males, 1 female), who underwent alumina ceramic-on-ceramic total hip arthroplasty (trident cup, 2 cemented DEDICACE stem and one cementless ABG stem, Stryker) complained of a squeaking. The femoral head diameter was 32 mm in 2 cases and 28 mm in 1 patient. The mean age was 61.3 (56 to 68) years and the body mass index was 22.3 kg/m² (19.4 to 27.8) (Table 1). All the patients presented immediately after surgery a reproducible loud squeaking at each step when walking, at the end of the stance phase as the hip was fully extended. Patients accepted to perform a CT-scan to assess the three-dimensional hip anatomy using a specific software Hip-Plan [11]. The following parameters were assessed: the femoral offset, the height of the head femoral center from the top of the great trochanter, the coordinates of the hip rotation center and the anteversion values.

The same measurements were performed on the healthy contralateral hip; in order to compare the three-dimensional hip anatomy between the replaced hip and the natural healthy

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Table 1
Clinical data of the squeaking patients.

Case	Sex	Age	Height (cm)	Weight (kg)	BMI	Dislocation
1	M	68	180	90	27.8	No
2	F	56	170	56	19.4	No
3	F	60	160	50	19.5	No

BMI: body mass index.

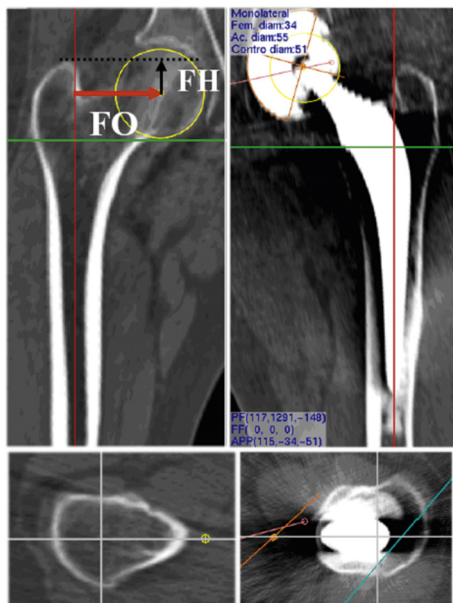


Fig. 1. The femoral anteversion, the femoral offset and the height from the top of the great trochanter to the femoral head center were measured and compared to the natural values on the contralateral side.

contralateral hip (Figs. 1 and 2). The true three-dimensional limb length discrepancy (LLD) was determined.

In the 3 squeaking patients, high values of the cup and the stem anteversion angles were found. These values were significantly increased (2 folds) in comparison to the contralateral non-replaced hip (Table 2). Indeed, the mean stem anteversion value was $36.3 \pm 12.9^\circ$, increased by $21^\circ \pm 15^\circ$ in comparison to the contralateral side. The mean cup anteversion angle was $42 \pm 3.6^\circ$,

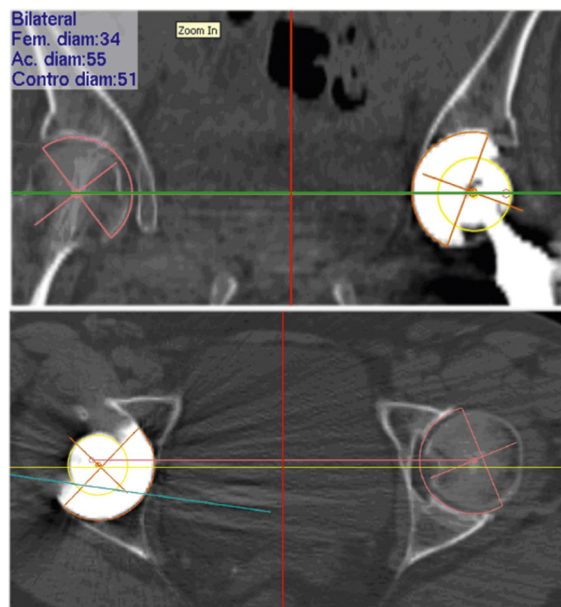


Fig. 2. The acetabular anteversion and the coordinates of the hip center of rotation were measured on the replaced hip and the contralateral healthy hip.

increased by $19.3 \pm 9^\circ$ in comparison to the contralateral side. Thus, the global anteversion angle was $78.3^\circ \pm 9.7^\circ$, increased by $43.6^\circ \pm 11^\circ$ in comparison to the contralateral side, corresponding to a 2 fold increase (Fig. 3). All patients presented on the CT-scan, evidence of posterior neck-rim impingement (Fig. 4). The cup abduction angle was found to be extremely high in one case (72°). In two cases, the X-rays showed that the liner was not fully seated inside the metal back.

The 3 patients had a lengthening of about $16 \text{ mm} \pm 6$ on the squeaking side (8 to 20 mm). The femoral offset was increased by 15 mm (44%) in one case and decreased by 8 mm (19%) in one case (Table 3). The hip rotation center was excessively shifted medially (13 mm) and posteriorly (5 mm) in one patient. One patient was revised and the retrievals showed evidence of anterior edge loading with stripe wears (Fig. 5). The squeaking disappeared in this patient but remained in the 2 other ones.

Comparison of Anteversion angles between Squeaking Hips and contro-lateral natural Hip

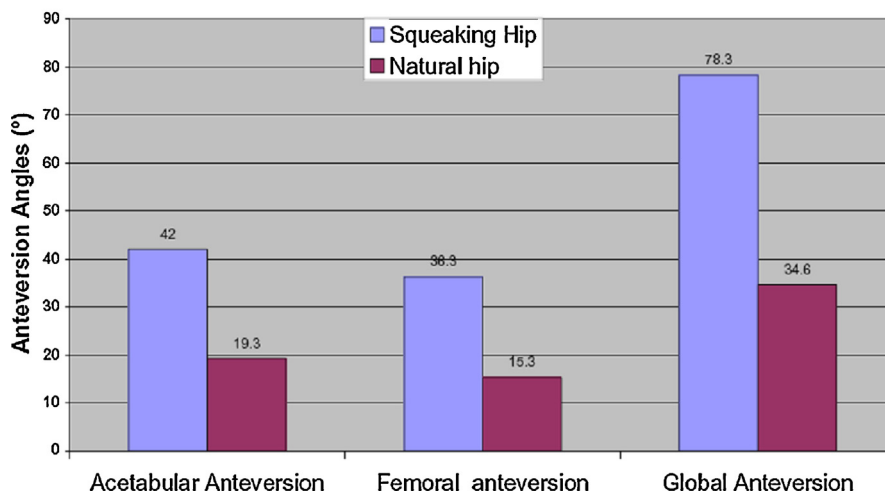


Fig. 3. Comparison of the anteversion angles between the squeaking hips and the contralateral natural hips.

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