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Oversized Cups as a Major Risk Factor of Postoperative Pain After Total Hip Arthroplasty

Guillaume A. Odri, MD, Giovany B. Padiolleau, MD, François T. Gouin, MD, PhD

Clinique Chirurgicale Orthopédique et Traumatologique, CHU Hôtel Dieu, Nantes, France

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ABSTRACT

After total hip arthroplasty (THA) some patients have persistent postoperative pain (POP). Some of these POP are anterior and are caused by an anterior iliopsoas impingement (AIPI). We have hypothesized that oversized implanted cups could be responsible for POP and especially AIPI. We screened 237 patients who had a primary THA and compared the size difference (ΔS) between the native femoral head and the implanted cup, in patients with and without POP. Median ΔS was 2 mm [−6; 11 mm] and patients with POP had a significantly increased ΔS ($P < 0.0001$). The threshold above which pain was significantly more frequent was ΔS ≥ 6 mm. Odds ratio was 14.4 for POP and 26 for AIPI pain when ΔS ≥6 mm.

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Primary total hip replacement (THA) aims for immediate and long lasting effects on pain and function in osteoarthritic hips. Several studies report major improvements on gait and range of movement 6 months after THA [1,2]. Brander et al [3] showed that 100% of the patients had an improvement of the pain after primary THA, with an associated benefit on function for patients over 80 years old, and Clement et al [4] found a mean 12 points increase (out of 24) in the pain component of the Oxford hip score after primary THA before and after 80 years old.

However, despite these good results, persistent postoperative pain (POP) after THA has a reported incidence of 0 to 40% [5–9]. These POP have different origins: gluteus medius tendonitis [10], anterior iliopsoas impingement [10–14] (AIPI), fractures, psoas hematoma [9,11], poor implants positioning [13], heterotopic ossifications, septic or aseptic loosening [10], metal on metal friction [9,15], type of fixation and stem size [16]. Clinically, these POP have diverse localisations [17]: iliac crest, greater trochanter, anterior inguinal region, lateral, posterior to the buttock or to the thigh. Some of these anterior inguinal pains have been related to AIPI [10–14] and its prevalence is estimated around 4% of THA [7,8]. These AIPIs have been found related to long acetabular fixations screws [8,18], cup anteversion defect, antero-superior rim overhang, and oversized cups [8]. We hypothesized that oversized cups in THA were a major risk factor of POP and especially of anterior pain such as AIPI. We studied the statistical association between the cup oversize, which we called ΔS (difference between the implanted cup size and the native femoral head size) and POP (AIPI and non AIPI). We also studied the correlation between the cup position (anteversion and inclination) and POP, as retroverted cups have been previously associated with AIPI.

Materials and Methods

Patients

This is a monocentric retrospective study on 238 consecutive patients who had primary THA with cryopreservation of the femoral head between 2005 and 2010, because cryopreserved heads were systematically measured. Exclusion criteria for femoral head cryopreservation were:

- Past history of:
  - HIV, HTLV, HBV or HCV infection
  - Risk factors of these infections in the past 12 months:
    - Multiple sex partners
    - IV drug addiction
    - Blood derived product exposure
    - Imprisonment
  - Treatment by growth hormones, human dura mater graft or undocumented neurosurgery
  - Dementia, neurological disease suspicious of subacute spongiform encephalopathy or familial history of subacute spongiform encephalopathy
  - Malignant disease
  - Systemic disease

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Reprint requests: Guillaume A. Odri, MD, Clinique Chirurgicale Orthopédique et Traumatologique, CHU Hôtel Dieu, 1 place Alexis, Ricordeau 44093, Nantes Cedex 1, France.

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- Running infection: proven or suspected viral disease, tuberculosis, leprosy, parasite infection, disseminated mycotic infection, Chikungunya exposure <21 days or ongoing infection.
- Local pathology: past radiotherapy or infection of the hip
- Pre-operative examination: adenopathy, hepato-splenomegaly, jaundice, needle injections (drug addiction suspicion), tattoo or piercing <12 months.

One of these criteria was sufficient for exclusion. All the femoral heads where registered in the local tissue bank with the patients ID and the size of the femoral head in millimetres (mm). All patients were informed and consented for cryopreservation of their femoral head as current practice. Median age was 69.1 years old [34.9–89.7]. There were 121 women and 117 men. Mean follow up was 792.5 days [139–2591]. All patients had surgery in the same hospital by 16 different surgeons.

Data Collection

All postoperative complications were collected but only pain was analyzed in this study. The patients were divided into 3 groups: no pain group, AIPI pain group and non AIPI pain group. Data collection was done by the surgeons in the outpatient clinic and written in the clinic notes. Data collected during the last follow up consultation were used for this study. AIPI pain was defined as postoperative anterior hip pain in the groin mentioned by the patient after interrogation in consultation, and present during examination when active flexion of the hip was performed and decreased during passive flexion of the hip. Non AIPI pains were all the other pains around the hips mentioned by the patient after interrogation in consultation, excluding spinal or abdominal pains. For exhaustiveness, all mentioned hip pains were recorded as POP, and no difference was made according to frequency, intensity, time of onset after surgery. Other complications found were 19 dislocations (8%), 2 infections (0.85%) and 6 others (3.4%, hematoma, fracture). No loosening was found at the last follow up.

Data concerning the implants were collected from the operative notes. Cryopreserved femoral head sizes were determined with a calliper by one technician at the tissue bank and cup sizes were collected from the operation notes and hardware traceability. Two hundred twenty-five patients had an uncemented cup with no bone graft and 13 had a cemented cup. There were 230 standard cups and 8 dual mobility cups. Bearing surfaces were metal on UHWPE, ceramic on UHWPE or ceramic on ceramic; no metal on metal implants were used. The surgical approach was posterior in all of the cases.

Cup positioning parameters were measured by pelvis AP, hip AP and profile x-rays done routinely at 1.15 magnification for all patients. Cup anteversion angle was measured according to Lewinnek [19] on pelvis AP x-rays (Fig. 1). D1 and D2 lengths are measured and version $= \sin^{-1}(D2/D1)$. Ante- or retro-version were determined by comparing the size of the ellipse formed by the projection of the acetabular rim on pelvis AP and hip AP x-rays. If the ellipse is thinner on pelvis AP, then the cup is anteverted and vice-versa. Cup inclination angle was measured on the AP views between the horizontal line and the cups axis.

Studied Variable

We calculated the difference between the implanted cup size (ICS, size of the outer rim of the implant) and the native femoral head size (NFHS, size of the largest diameter of the femoral head): $\Delta S = ICS - NFHS$. The main objective was to determine if there is a statistical relationship between ΔS and POP (AIPI pain and non AIPI pain).

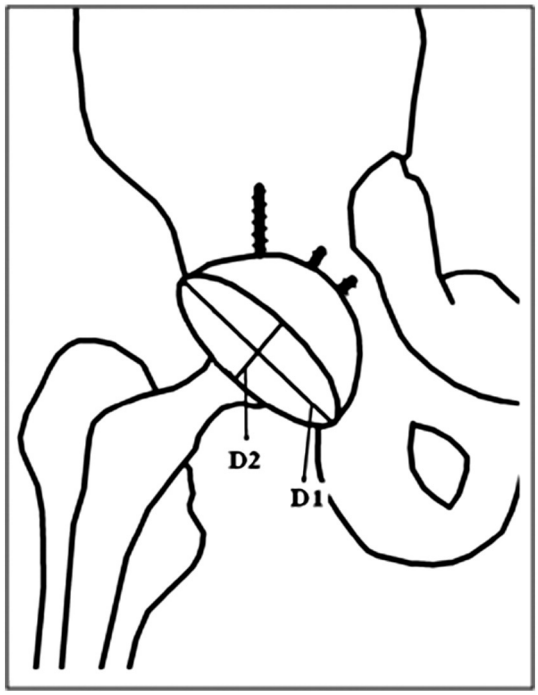

Fig. 1. Cup anteversion angle measured according to Lewinnek [19] on pelvis AP x-rays. D1 and D2 lengths are measured and version $= \sin^{-1}(D2/D1)$. Ante- or retro-version were determined by comparing the size of the ellipse formed by the projection of the acetabular rim on pelvis AP and hip AP x-rays.

Statistical Analysis

AIPI and non AIPI pain groups of patients were compared to the no pain group by a non parametric Wilcoxon test. Correlation analysis between numeric variables (NFHS, ICS, ΔS, anteversion and inclination) were performed and Spearman's ρ coefficients were determined. Multivariate analysis consisted of stepwise multiple discriminant analysis to determine which variables were linked to POP. Odds ratio was calculated between POP (AIPI + non AIPI) and no pain group and between AIPI pain group, non AIPI pain group and no pain group after transforming ΔS variable into a categorical variable with 2 values: $\Delta S < 6$ mm and $\Delta S \geq 6$ mm. The difference was considered significant for $P < 0.05$.

Results

Thirty two patients had POP (13.5%): 11 had AIPI pain (4.6% of patients, 34.4% of POP) and 21 had non AIPI pain (8.9% of patients, 65.6% of POP). The other 206 patients had no pain. Median age was 69.1 [34.9–89.7]. It was 68.9 [37.7–89.7] in the no pain group, 66.4 [46.4–86.2] in the AIPI pain group and 73.3 [34.9–85.2] in the non AIPI pain group. The difference was not significant.

None of the 19 patients with a dislocation, 2 patients with sepsis and 6 patients with other complications had POP at last follow up.

Median NFHS was 50 mm [41–60 mm] in the no pain group, 51 mm [43–56] in the AIPI pain group and 46 mm [44–56] in the non AIPI pain group. The difference was significant ($P = 0.0068$), and non AIPI patients had significantly smaller NFHS. Median ICS was 52 mm (46–63 mm) in the no pain group, 54 [52–62] in the AIPI pain group and 52 [48–60] in the non AIPI pain group. AIPI pain group had a significantly higher ICS than in no pain group ($P = 0.04$). Median anteversion was 18° [1°–48°] in the no pain group. It was 11° [3°–26°] in the AIPI pain group and 21° [8°–34°] in the non AIPI pain group. Anteversion was significantly higher in the non AIPI pain group ($P = 0.047$) compared to the no pain group. Median inclination was 46° [20°–75°] in the no pain group. It was 40° [20°–56°] in the AIPI pain

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