Component positioning in primary total hip replacement: A prospective comparative study of two anterolateral approaches, minimally invasive versus gluteus medius hemimyotomy

F. Mouilhade, J. Matsoukis, P. Oger, C. Mandereau, V. Brzakala, F. Dujardin

Academic Department of Orthopedic Surgery and Traumatology, Rouen University Hospital, 1, rue de Germont, 76000 Rouen, France
Orthopedic Department, Le Havre Hospital Group, J. Monod Hospital, 29, rue Pierre-Mendès, 76290 Montivilliers, France
Orthopedic Department, Mignot Hospital, 177, route de Versailles, 78157 Le Chesnay, France

Accepted: 27 May 2010

SUMMARY

Introduction: One factor of implant survivorship in total hip replacement (THR) is the quality of implant choice and positioning. The purported advantages of minimally invasive approaches are faster recovery, shorter hospital stay and less peri-operative blood loss. On the other hand, there have been many reports of higher complication rates, and doubts as to the quality of implant positioning.

Hypothesis: The quest to minimize tissue damage is at the cost of THR positioning quality.

Objectives: To assess implant positioning in a prospective comparative continuous multicenter series.

Patients and methods: Between 2008 and 2009, a prospective comparative study was conducted on a continuous series of 141 THRs. Ninety-two were performed in two centers, using a minimally invasive Watson-Jones approach; the other 49, performed in a 3rd center, used an anterolateral approach with anterior hemimyotomy. The surgeons were in all cases experienced in their technique. Short-term follow-up comprised clinical and functional (Postel Merle d’Aubigné (PMA),...
Harris, SF12, WOMAC) and biological assessment (serum creatine phosphokinase (CPK), myoglobinemia, hematocrit) and analysis of complications and of implant positioning on X-ray and CT-scan.

Results: On the Watson-Jones approach, surgery time was longer; day-1 analgesic administration was lower; PMA, Harris and WOMAC scores were better at 6 weeks; and CPK levels were lower at 24 and 48 hours. There were no significant differences on the other clinical and biological criteria. Implant positioning analysis revealed significantly greater combined anteversion and greater variation in acetabular inclination mean with the Watson-Jones approach, but no differences in cup positioning, femoral stem positioning, or limb length discrepancy.

Discussion: The minimally invasive Watson-Jones approach provided faster recovery and less muscular damage. However, implant positioning was less precise in terms of acetabular cup inclination.

Level of evidence: Level III. Prospective, comparative, non-randomized.

© 2010 Elsevier Masson SAS. All rights reserved.

Introduction

In total hip replacement (THR), the benefit of a minimally invasive or reduced approach remains unproven. The 1st reports were of mini-incisions of less than 10 cm [1—4], which were quickly assimilated to the concept of minimal invasion [4—7], especially as concerned dual approach techniques. Clinical differences between approaches diminish over follow-up (between 6 months and 1 year, according to the series [8—10]), raising the question of the longer-term benefit associated with mini-incisions. The prime objective thus becomes implant survivorship, which is dependent upon implantation quality [11—16]. It has not been demonstrated that minimizing the surgical approach does not adversely affect this parameter, even in the hands of experienced surgeons. The present study compared two THR approaches, the standard anterolateral transgluteal (Thomine et al.) approach [17] and a reduced anterolateral (mini-Watson-Jones or Rottinger) approach [18], with implant positioning as principal assessment criterion.

Patients and methods

Patients

In the present multicenter prospective study, three French centers (Le Havre, Versailles, and Rouen) each assessed a continuous series of primary intention THR. Surgery in each center was performed under the supervision of a single surgeon experienced in the procedure in question (JM in Le Havre, PO in Versailles, and FD in Rouen). Ninety-two operations used the mini-Watson-Jones approach: 42 in Versailles (mWJ1) and 50 in Le Havre (mWJ2); and 49, in Rouen, used Thomine’s anterior hemimyotomy (AHM).

Inclusion was from January 2008 to January 2009. Inclusion criteria were primary intention THR, for whatever etiology, free of major architectural disorder (i.e., of associated acetabular or femoral surgery), and using similar implant models comprising a metal-polyethylene friction couple, a cemented cup, and a Charnley-type monoblock or modular 22.2 mm-caliber cemented femoral stem. The precise model was not imposed by the study protocol but left to the surgeon’s choice. Exclusion criteria were associated major architectural disorder, and local history of surgery; body mass index did not feature as an exclusion criterion.

The protocol was approved by the Comité de protection des personnes ethics committee as part of an assessment series for functional recovery following THR.

Methods

Pre-operative data comprised age, gender, height and weight, etiology, socio-economic status, sports level and American Society of Anesthesiologists (ASA), Charnley [19], Postel Merle d’Aubigné [20] and Harris [21] scores. In all groups, hip osteoarthritis was mainly primitive; patients were almost all retired and non-athletic. Table 1 shows characteristics for the three groups.

Surgery was systematically performed under general anesthesia, with the patient in lateral decubitus. For the standard anterolateral approach the procedure was as described by Thomine et al. [17] and, for the mini-antrolateral approach, as described by Bertin and Rottinger [18]. The theoretic cup position was in 45° inclination and 15° anteversion, with 15° anteversion for the femoral stem.

Post-operative management was identical in the three departments as regards analgesia, immediate upright posture, transfusion strategy and thromboprophylaxis.

The per-operative and early post-operative clinical assessment criteria were operation time, per-operative blood loss (quantified as exclusive aspiration minus lavage volumes), need for transfusion, complications, hospital stay, and discharge home or to convalescence. Biological markers were pre-operative hematocrit evolution to post-operative D1, myoglobinemia at 10 h, and CPK levels at 24 h and 48 h.

Implant position was assessed from weight-bearing X-ray and CT-scans. Cup inclination was determined; on weight-bearing AP X-ray views, as the angle between the tear-drop line and the projection of the opening of the cup. Cup anteversion was determined, on CT-scan, as the angle between the projection of the opening of the cup and the angle subtended by a perpendicular to the tangent of the posterior edges of the posterior acetabular wall. Femoral anteversion was determined, on CT-scan, as the angle between the neck axis and the tangent of the posterior edge of the femoral condyles. Combined anteversion was determined as the sum of cup plus femoral stem version. For each position criterion, several good-position sectors were defined on the basis
Table 1  Pre-operative epidemiological data for the three series: mean ± SD (range). Significance threshold, \( P=0.05 \).

<table>
<thead>
<tr>
<th></th>
<th>AHM</th>
<th>mWJ1</th>
<th>mWJ2</th>
<th>AHM/mWJ1</th>
<th>AHM/mWJ2</th>
<th>mWJ1/mWJ2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>49</td>
<td>42</td>
<td>50</td>
<td>&lt; 0.0001</td>
<td>0.03</td>
<td>0.015</td>
</tr>
<tr>
<td>Age (years)</td>
<td>62 ± 14 (37/87)</td>
<td>73 ± 8 (41/85)</td>
<td>68 ± 11 (35/88)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex ratio (F/H)</td>
<td>18/31</td>
<td>29/13</td>
<td>32/18</td>
<td>0.006</td>
<td>0.03</td>
<td>NS</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>25.9 ± 4 (17.6/38)</td>
<td>25.8 ± 3.2 (19.6/33)</td>
<td>26.6 ± 3.8 (20.2/34.2)</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>ASA score (%)</td>
<td>1</td>
<td>39</td>
<td>17</td>
<td>0.04</td>
<td>0.03</td>
<td>0.001</td>
</tr>
<tr>
<td>Charnley score (%)</td>
<td>2</td>
<td>45</td>
<td>68</td>
<td></td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>Etiology</td>
<td>3</td>
<td>16</td>
<td>15</td>
<td></td>
<td>14</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>24</td>
<td>44</td>
<td>NS</td>
<td>NS</td>
<td>0.0003</td>
</tr>
<tr>
<td></td>
<td>53</td>
<td>69</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>7</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>32</td>
<td>41</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>5</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work status</td>
<td>37</td>
<td>40</td>
<td>37</td>
<td>NS</td>
<td>NS</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1.01</td>
<td>NS</td>
<td>0.01</td>
</tr>
<tr>
<td>Activity level</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Devane)</td>
<td>3</td>
<td>30</td>
<td>38</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>10</td>
<td>3</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>7</td>
<td>1</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R/L ratio</td>
<td>27/22</td>
<td>18/24</td>
<td>17/33</td>
<td>NS</td>
<td>0.016</td>
<td>NS</td>
</tr>
<tr>
<td>Pre-operative PMA score</td>
<td>12.4 ± 2 (9/16)</td>
<td>11.6 ± 2 (6/15)</td>
<td>11.8 ± 2.4 (5/15)</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Pre-operative Harris score</td>
<td>46.4 ± 14.6 (11/74)</td>
<td>40.8 ± 13.4 (10/66)</td>
<td>51.6 ± 14.9 (16/81)</td>
<td>NS</td>
<td>NS</td>
<td>0.001</td>
</tr>
</tbody>
</table>

AHM: anterior hemimyotomy; mWJ1: mini-Watson-Jones group 1; mWJ2: mini-Watson-Jones group 2. BMI: Body Mass Index.

\(^a\) Rapidly destructive osteoarthritis of the hip.


of literature recommendations [11–13,22–25]. Series were then compared pairwise on contingency tables.

Early post-operative radio-clinical follow-up at 6 weeks assessed scar size, limping, mobility and pain; complications were noted; physical PMA [20] and Harris [21] scores and functional WOMAC [26] and SF12 [27] scores were calculated on the validated French versions of the tests. X-ray assessment completed the study of positioning in terms of femoral varus/valgus, measured to within 3°, and of lengthening and the implant contribution to lower limb length inequality as assessed by the distance between the tear-drop line and the tangent of the lesser trochanter. Lengthening and the implant contribution to lower limb length inequality were measured as the distance between the tear-drop line and the tangent of the lesser trochanter, following Ranawat et al. [28].

Statistical analysis used the GraphPad inStat software package (version 3.05). Qualitative data were compared on Fisher test. Quantitative data were analyzed on the Student test, with Welch correction when standard deviations were significantly different, and by Mann-Whitney test when distributions were non-normal. Variances were compared on the Fisher-Snedecor test. The significance threshold was set at \( P=0.05 \).
Results

Per- and peri-operative data

Surgery time, from incision to dressing, was significantly longer using a mini-Watson-Jones approach (Table 2). Hospital stay varied between centers; only one of the two centers using a mini-incision had significantly shorter hospital stays (by nearly 3 days), with patients more often being discharged home (Table 2). Morphine administration during the first 24 h was significantly lower in case of mini-incision, with also a significant difference between the two centers concerned.

Scar size was significantly smaller with the mini-incision, but sometimes exceeded the definition of a mini-incision, up to 14.5 cm. There was a significant difference (mean, 1.5 cm) in scar size between the two mini-Watson-Jones groups.

Bleeding and muscular lesions

Bleeding and the number of transfused concentrates were equivalent between the two mini-Watson-Jones groups and between them and the AHM group (Table 3). Mean per-operative blood loss ranged from 361 to 401 ml between groups (NS) (Table 3). Hematocrit reduction from pre-operative to D1 levels was similar between the three groups. One AHM-group patient was excluded due to per-operative transfusion. Biological assessment of muscular markers, on the other hand, showed contrasting results. Myoglobinemia at 10 h was similar between the three groups, but 24 h and 48 h CPK levels were significantly higher in the AHM group (Table 3).

Early post-operative course

One of the two mini-incision centers did not use the functional WOMAC or SF12 scores in follow-up. Recovery at 6 weeks was significantly better with mini-incision, in terms of PMA and Harris scores, and of WOMAC score in the center, which assessed this (Table 4). No significant difference in SF12 score emerged between groups.

There was no significant difference in complications, defined as any adverse per- or post-operative event up to 3 months, between the three groups. In the AHM group, one patient was treated for pulmonary embolism with probable

---

### Table 2 Peri-operative clinical data: mean ± SD (range).

<table>
<thead>
<tr>
<th></th>
<th>AHM</th>
<th>mWJ1</th>
<th>mWJ2</th>
<th>AHM/mWJ1 (P)</th>
<th>AHM/mWJ2 (P)</th>
<th>mWJ1/mWJ2 (P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgery time (min)</td>
<td>71 ± 16 (40/120)</td>
<td>93 ± 20 (64/148)</td>
<td>94 ± 15 (70/130)</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
<td>0.68</td>
</tr>
<tr>
<td>Hospital stay (days)</td>
<td>10 ± 3 (7/20)</td>
<td>9 ± 2 (6/19)</td>
<td>7 ± 1 (5/12)</td>
<td>0.1</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Home/convalescence discharge ratio</td>
<td>32/14</td>
<td>16/25</td>
<td>36/14</td>
<td>0.005</td>
<td>0.8</td>
<td>0.003</td>
</tr>
<tr>
<td>24 h morphine dose (mg)</td>
<td>33.6 ± 23.6 (4/100)</td>
<td>11.8 ± 9.8 (0/36)</td>
<td>2.6 ± 7.4 (0/40)</td>
<td>0.0002</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Scar size (mm)</td>
<td>15.6 ± 1.7 (14/21)</td>
<td>8.2 ± 1.3 (6/12.5)</td>
<td>9.7 ± 1.4 (7/14.5)</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

AHM: anterior hemimyotomy; mWJ1: mini-Watson-Jones group 1; mWJ2: mini-Watson-Jones group 2. *P* values in bold indicate significant difference.

---

### Table 3 Bleeding and muscular lesion data. Mean ± SD (range).

<table>
<thead>
<tr>
<th></th>
<th>AHM</th>
<th>mWJ1</th>
<th>mWJ2</th>
<th>AHM/mWJ1 (P)</th>
<th>AHM/mWJ2 (P)</th>
<th>mWJ1/mWJ2 (P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per-operative blood loss (ml)</td>
<td>361 ± 163 (200/900)</td>
<td>401 ± 233 (100/1200)</td>
<td>393 ± 213 (100/1000)</td>
<td>0.46</td>
<td>0.52</td>
<td>0.86</td>
</tr>
<tr>
<td>Hematocrit reduction (1/17)</td>
<td>8.4 ± 3.6 (1/17)</td>
<td>7.9 ± 4.1 (0.9/22.5)</td>
<td>9 ± 4.4 (–1/18.3)</td>
<td>0.6</td>
<td>0.5</td>
<td>0.7</td>
</tr>
<tr>
<td>Transfusion (concentrates)</td>
<td>0.13 ± 0.7 (0/5)</td>
<td>0.35 ± 0.9 (0/4)</td>
<td>0.1 ± 0.5 (0/3)</td>
<td>0.37</td>
<td>0.98</td>
<td>0.35</td>
</tr>
<tr>
<td>10-h myoglobinemia (μg/l)</td>
<td>266 ± 178 (51/495)</td>
<td>285.7 ± 185 (24/1010)</td>
<td>327 ± 191 (75/961)</td>
<td>0.68</td>
<td>0.18</td>
<td>0.35</td>
</tr>
<tr>
<td>24-h CPK (μg/l)</td>
<td>534 ± 304 (71/1421)</td>
<td>480.6 ± 408 (140/1923)</td>
<td>370.7 ± 175.9 (88/1125)</td>
<td>0.037</td>
<td>0.0055</td>
<td>0.8</td>
</tr>
<tr>
<td>48-h CPK (μg/l)</td>
<td>479 ± 370 (163/1635)</td>
<td>385 ± 352 (100/1396)</td>
<td>303.8 ± 193 (95/1028)</td>
<td>0.04</td>
<td>0.023</td>
<td>0.9</td>
</tr>
</tbody>
</table>

AHM: anterior hemimyotomy; mWJ1: mini-Watson-Jones group 1; mWJ2: mini-Watson-Jones group 2. *P* values in bold indicate significant difference.
transitory ischemic event; one superficial infection was successfully managed by local treatment and antibiotics; and one patient suffered persistent disabling hip pain for which no cause could be determined. In mini-Watson-Jones group 1, there was one case of pulmonary embolism; in the 2nd group, one case of femoral shaft perforation was managed during surgery, and one thigh hematoma resolved without reoperation.

### Implant positioning

Forty-five of the 49 AHM-group patients had undergone CT-scan for implant positioning at the time of writing; one refused to do so, and three others had not been scanned. Four of the 42 patients in the 1st mini-Watson-Jones group had not been scanned but all those in the 2nd group had been (Table 5). Cup inclination was shallower in the 2nd mini-Watson-Jones group. Mean acetabular anteversion in the 1st mini-Watson-Jones group was greater than in the other two groups, as was femoral anteversion (Table 5). In terms of combined anteversion, implant positioning differed according to approach, the AHM group showing significantly less than the two mini-Watson-Jones groups (Table 5).

To assess whether there were any differences in implant positioning quality, a number of theoretic position sectors were determined from literature recommendations. Pairwise comparison between series was performed to draw up contingency tables. Whatever the theoretic positioning sector [11-13,22-25], no significant differences emerged according to approach. A 2nd analysis compared distribution around the mean position, by comparing group variances on Fisher-Snedecor F test (Table 6); cup inclination range proved significantly greater in the mini-incision groups, while cup, femur and combined anteversion did not differ.

### Discussion

#### Clinical follow-up

Most studies of mini-incisions reported simpler post-operative course and benefit in terms of post-operative pain, per- and post-operative bleeding, decubitus-related...
complications and recovery time [22,29–32]. Some series were selected according to body mass index [4,30], or discharge home and active involvement in rehabilitation [33,34].

Other reports, mainly involving double incision approaches, were more reserved or even negative [4—6]. Long-term clinical results were similar between approaches [2,3,23,31,32,35,36]. DiGioia et al. [2] reported a prospective randomized comparison between mini-incision and a posterior approach for THR. At 6 months, results with the mini-incision were still better than with the posterior approach in terms of limp, walking distance and stair climbing, but at 1 year there were no differences between the two groups. Wright et al. [3] found no differences according to approach at 5 years’ FU. Ogonda et al. [37], in a prospective, randomized, double-blind study, found no difference in immediate recovery between a standard approach and posterior mini-incision. Wall et Mears [38] reviewed the entire literature on mini-incision in hip surgery; up to February 2008, only nine randomized comparative trials had been published, and the sole significant difference lay in reduced bleeding with the mini-incision, and even here no clinical impact could be proved. Confusion factors may account for differences reported in other series: for example, Pour et al. [39] demonstrated that post-operative course in THR was more dependent on preconditioning than on incision length.

In the present series, recovery at 6 weeks was better with the mini-Watson-Jones approach than with AHM, on our objective and functional criteria (PMA, Harris and WOMAC); no such difference was found on SF12. These results are to be interpreted with caution: there were some significant differences between the two types of group. The group operated on by AHM was significantly younger than the two mini-Watson-Jones groups (respectively, P < 0.0001 and P = 0.03), with a significantly different sex ratio (respectively, P = 0.0064 and P = 0.03) and Devane activity level. This represents a real bias, inasmuch as younger THR patients are likely to recover more rapidly, and also to be more demanding and severe in their self-assessments. There were no significant differences on the other study criteria (BMI, ASA and Charnley scores, PMA and Harris scores, or etiology).

Given these findings, the lower CPK elevation observed at 24 h and 48 h is interesting. Myoglobinemia and CPK were assayed at their recognized serum peak following surgical aggression [40,41]. Myoglobinemia falls off more rapidly than CPK from its peak value, leaving a tighter sampling interval, which might explain why no significant difference according to approach was found with this marker. A cadaver study of THR found that double incision induced gluteus medius and external rotator lesions, whereas posterior mini-incision induced external rotator lesions [7]. Muscle lesions also differed in type: sectioning on the Thomine approach, and stretching on the mini-Watson-Jones approach; better clinical recovery may thus come down to better recovery from muscle stretch lesions. Madsen et al. [42] comparing gait recovery between standard posterior and anterolateral approaches, found persistent inclination of the trunk and greater right/left loading asymmetry at 6 months with the anterolateral approach: i.e., residual muscle deficit at 6 months was associated with an approach involving the abductor system. Meneghini et al. [43], however, in a short prospective randomized opto-electronic analysis of gait according to three mini-approaches in THR (anterolateral, posterior and double), observed no significant differences in recovery. The anterolateral approach appeared to be associated with reduced mid-pace reaction strength on the ground compared to the other approaches; in fact, however, the difference concerned the pre-operative situation of those patients managed by an anterolateral approach, whereas no difference was to be observed post-operatively. The authors affirmed that an anterolateral approach was associated with persistent abductor system lesion, despite the absence of any significant difference and the fact that all assessment parameters pointed to more well-balanced right/left distribution of weight-bearing.

### Implant positioning

All of the above criteria, however, may be said to be secondary. Others, such as enduring function, implantation quality and implant survivorship, are more directly relevant. Certain reports were encouraging on these points, finding no increase in implant malposition with mini-incision [3,44,45]. Others were more reserved, such as that by Woolson et al. [4], who reported poorer acetabular positioning with posterior mini-incision; their conclusions, however, are to be taken with caution due to certain limitations and bias: mini-incision group patients were selected, there were three surgeons, all with little experience using this approach, and follow-up was short.

Analyzing the distribution of implant position around the mean sheds a more useful light, better reflecting the quality of positioning. In the present study, the AHM group showed less variation in cup inclination than the mini-Watson-Jones groups. There were no significant differences in the other positioning criteria.

<table>
<thead>
<tr>
<th>Table 6 Implant positioning ranges.</th>
<th>Variance</th>
<th>Test F</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AHM</td>
<td>mWJ1</td>
</tr>
<tr>
<td>Cup inclination</td>
<td>10.00</td>
<td>22.76</td>
</tr>
<tr>
<td>Cup anteversion</td>
<td>67.90</td>
<td>40.26</td>
</tr>
<tr>
<td>Femoral anteverision</td>
<td>63.44</td>
<td>55.08</td>
</tr>
<tr>
<td>Combined anteverision</td>
<td>179.38</td>
<td>110.05</td>
</tr>
</tbody>
</table>

AHM: anterior hemimyotomy; mWJ1: mini-Watson-Jones group 1; mWJ2: mini-Watson-Jones group 2. P values in bold indicate significant difference.
THR component positioning according to approach

The implant positioning analysis method is open to discussion. X-ray assessment of cup inclination, femoral varus/valgus and lengthening has been validated [28,46]; acetabular anteversion assessment, on the other hand, shows low reproducibility. Various radiographic methods exist [11,47—50]. CT measurement is the most precise, but cannot be performed under loading. All of the measurement techniques available take the ground as reference, irrespective of the spatial position of the pelvis [50], although Tannast et al. [46] demonstrated that sagittal variation in pelvic position affected the measurement of version but not of inclination. Pelvis position can be taken into account in calculating cup positioning [50].

Hart et al. [10] found no significant differences in implant position on X-ray (inclination and femoral anteversion and alignment) between standard posterior and minimally invasive approaches; this was, however, a purely radiographic analysis, and involved patient selection. Chen et al. [9], on a similar analysis, reported significantly less cup inclination and greater anteversion with double mini-incision compared to a standard transtrochanteric approach, although positioning was within the "good" sector in all cases; the study was retrospective, and the "good" was not defined, nor was it specified whether the same surgeon performed both types of operation. In the present study, CT analysis of implant positioning found a significant difference in acetabular inclination and in acetabular and femoral anteversion in only one of the two mini-Watson-Jones groups as compared to the AHM group: the difference was thus not dependent and not a question of approach. Nor did this difference mean that results in one group were good and in the other poor: both fell within the sector of good positioning, however this was defined. Normal positioning criteria in the literature include dislocation risk [11,12], limitation of mobilities [13,14] with cam-effect and elevated dislocation risk, and risk of loosening and implant failure [15,16,23,33,44]; such variable criteria make comparison between series difficult. Above all, these considerations testify to the broad tolerance of implant positioning in THR with a metal/polyethylene friction couple.

Conclusion

In the present continuous prospective comparative series, frontal cup positioning was less precise using an anterolateral mini-incision than with AHM. It confirmed the short-term clinical benefit and reduced muscular aggression associated with the mini-Watson-Jones approach. Longer-term clinical follow-up might show whether this positioning difference impacts implant survivorship.

Conflict of interest statement

None.

References


[21] Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An


