 Obesity Does Not Affect The Accuracy of Acetabular Cup Implantation in Total Hip Replacement

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Citation

Abstract
Post-operative radiographs of 111 patients who had undergone cemented Total Hip Replacement performed or supervised a single surgeon (GCF) were analysed. All surgeries were performed via an anterolateral approach with patients in the lateral position. Patients were stratified according to Body Mass Index (BMI) into three groups (healthy, overweight and obese) and acetabular cup angles measured.

Mean values for cup abduction angle were similar for all three groups (44.5°, 46.8°, 44.0° respectively, p=0.335). Furthermore there were no differences in mean cup anteversion between groups (11.6°, 12.2°, 10.7 respectively, p=0.665). We conclude that obesity does not influence the accuracy of cup positioning in Total Hip Replacement.

INTRODUCTION
Total hip replacement is one of the most commonly performed adult reconstructive procedures that provides pain relief, functional improvement and improved quality of life for thousands of patients each year worldwide. The accuracy of implantation of total hip replacement (THR) components is fundamental to the function, stability and the longevity of the implants. Whilst the components are inserted as accurately as possible with reference to anatomical landmarks and various intra-operative guides, their position is subject to variation and surgical error.

Total hip arthroplasty is performed with the patient in a supine or lateral decubitus position. When performed with the patient in the lateral position the pelvis can rotate making positioning of acetabular component more difficult with some studies citing a tendency to position the cup in less than ideal anteversion and a more abducted or open position. Some surgeons believe that obese patients are more likely to be positioned incorrectly on the operating table and therefore the accuracy of implantation of their acetabular components is subjected to greater error.

The purpose of present study is to determine if obesity affects cup anteversion and abduction angle in THR.

MATERIALS AND METHODS
Between 1996 and 2005 two hundred and one Total Hip Replacements using the ZCA® cemented acetabular cup (Zimmer, Warsaw) were reviewed retrospectively. All surgeries were performed or supervised by a single surgeon (GCF). All cases were performed with the patient in the lateral position via an antero-lateral approach and the same bone cement (Palacos®, Zimmer, Warsaw) was used in each case. Of these patients 111 were considered to have sufficiently good quality antero-posterior pelvic or hip postoperative X-Rays available for analysis of cup anteversion and 72 of these patients had antero-posterior pelvic radiographs for measurement of cup abduction.

Abduction angle of acetabular cup is the angle between a horizontal reference line (line joining inferior teardrop points or inferior pubic rami or inferior points on sacroiliac joint) and the axis of opening of acetabular cup. On the radiographs of one hip joint the reference line cannot be drawn and abduction angle cannot be measured.

All radiographs were scanned to provide high definition TIFF images and the abduction and anteversion angles were measured using MATLAB® software (The MathWorks, Inc., USA). Cup anteversion angles were measured on either an AP radiograph centered on the hip (111 cases) or on an AP pelvic X-ray (72 cases). An ellipse of best fit was plotted onto the radio opaque wire marker of the acetabular cup and
the anteversion angle was then calculated using the software
to10,11,12. A correction factor of 4 degrees was added for
anteversion angles measured when pelvic radiographs
centred on the pubis symphysis were used as described by
Widmer13. For the cases with pelvic radiographs abduction
angle was calculated by plotting a horizontal reference line
between the most inferior point of the acetabular teardrops.
The cup inclination or abduction angle was then calculated
as the angle between a line through the long axis of the
ellipse and the horizontal reference line (Figure 1).

**Figure 1**
Figure 1: Measurement of inclination and anteversion angles

 Patients were stratified into groups for Body Mass Index
according to the World Health Organisation Classification of
obesity9. All measurements of BMI were taken less than two
weeks pre-operatively. Patients were categorised as: healthy
weight (BMI 18.5-24.9), overweight (BMI 25.0-29.9), grade
I obese (BMI 30.0–34.9), grade II obese (BMI 35.0–39.9) or
grade III obese (BMI≥40.0). The number of patients who
were grade II or grade III obese were small and considered
too small for statistical analysis therefore they were grouped
with the grade one obese group leaving three study groups –
healthy (BMI 18.5-24.9), overweight and obese (BMI≥30.0).

Of the 111 patients analysed thirty-nine patients were in the
healthy weight category, 49 were overweight and 23 were
obese (16 grade I obese, 6 grade II obese and 1 grade III
obese). Of the 72 patients who had pelvic radiographs centered on the
symphysis mean cup abduction angle was 45.4 ± 7.2° sd
(range 27.1° to 66.0°).

Neither the cup abduction angle nor the anteversion angle
was influenced by BMI (Table 2). Mean cup anteversion
angle was 11.6° for the healthy group, 12.2° for the
overweight group and 10.7° for the obese group (p=0.665).
Mean cup abduction angle was 44.5° for the healthy group,
46.8° for the overweight group and 44° for the obese group
(p=0.335).

**DISCUSSION**
The accuracy of implantation of components in Total Hip
Replacement is paramount to the success of the procedure.
The orientation of the acetabular component affects the
longevity of the prosthesis; wear of the bearing surfaces and
dislocation rate2,3. Ideally the acetabular component should

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**RESULTS**
Characteristics of the study groups are outlined in Table 1.

**Figure 3**
Table 1: Characteristics of the study groups.

<table>
<thead>
<tr>
<th></th>
<th>Healthy (n=39)</th>
<th>Overweight (n=49)</th>
<th>Obese (n=23)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (range)</td>
<td>72.6 (55-87)</td>
<td>71.1 (55-87)</td>
<td>68.1 (59-87)</td>
</tr>
<tr>
<td>Male:Female</td>
<td>17:12</td>
<td>26:23</td>
<td>7:16</td>
</tr>
<tr>
<td>Left:Right side</td>
<td>20:19</td>
<td>24:25</td>
<td>10:13</td>
</tr>
<tr>
<td>Mean BMI (range)</td>
<td>22.6 (18.9–24.5)</td>
<td>27.1 (25.0–29.5)</td>
<td>33.4 (30.0–48.1)</td>
</tr>
</tbody>
</table>

For all 111 patients in the study the mean cup anteversion
angle was 11.7 ± 6.7° sd (range 1.8° to 34.2°) For the 72
patients who had pelvic radiographs centered on the
symphysis mean cup abduction angle was 45.4 ± 7.2° sd
(range 27.1° to 66.0°).

**DISCUSSION**
The accuracy of implantation of components in Total Hip
Replacement is paramount to the success of the procedure.
The orientation of the acetabular component affects the
longevity of the prosthesis; wear of the bearing surfaces and
dislocation rate2,3. Ideally the acetabular component should
be implanted with an inclination angle of 35 - 45° and an anteversion angle of 0 - 15°. Acetabular cups are implanted with the aid of intra-operative alignment guides and the accuracy of implantation depends on the proper positioning of the patient and anatomical landmarks. The pelvis rotates intra-operatively with retraction of soft tissues and the femur. It has been postulated that in obese patients proper positioning of the patient upon the operation table is difficult and more retraction of soft tissues and the femur is required for visualisation of the acetabulum.

The aim of the present study was to determine if the accuracy of implantation of cemented acetabular component in total hip replacement is influenced by obesity. This study suggests that obesity has no effect on the accuracy of acetabular component implantation in total hip replacement. All 111 patients in the present study were operated by or under direct supervision of a single surgeon in the lateral position through anterolateral approach to the hip joint. The same acetabular component and bone cement was used in all the patients. Single observer took all the observations. The observer was blinded while measuring the angles from the radiographs using software.

The present study demonstrates that the obesity does not affect implantation of acetabular component in total hip replacement. Although patient positioning and adequate exposure of the acetabulum may be more difficult in the obese patient it is likely that the operating surgeon takes greater care in positioning the obese patient and in implanting the cup thus maintaining the accuracy of cup implantation.

Of the 23 patients in the Obese group 16 patients were grade one obese, 6 were grade two obese and 1 was grade three obese. The number of patients who were grade 2 and 3 obese were too small for statistical analysis and these patients were therefore grouped with those with grade 1 obese patients. This study has not addressed whether higher grades of obesity affect the accuracy of cup implantation. We would suggest that this could be an area for further work.

The present study shows that obesity does not affect orientation of acetabular component in total hip replacement however extra care may be required during patient set-up, exposure and cup implantation during Total Hip Replacement.

References
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