

# The importance of leg length discrepancy after total hip arthroplasty

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**We assessed leg length discrepancy and hip function in 90 patients undergoing primary total hip arthroplasty before surgery and at three and 12 months after. Function was measured using the Oxford hip score (OHS). After surgery the mean OHS improved by 26 points after three months and by 30 points after 12.**

**After operation 56 (62%) limbs were long by a mean of 9 mm and this was perceived by 24 (43%) patients after three months and by 18 (33%) after 12. The mean OHS in patients who perceived true lengthening was 27% worse than the rest of the population after three months and 18% worse after 12. In 55 (98%) patients, lengthening occurred in the femoral component. Appropriate placement of the femoral component could significantly reduce a patient's perception of discrepancy of length.**

Leg length discrepancy (LLD) after total hip arthroplasty (THA) has been associated with back pain and sciatica,<sup>1,2</sup> gait disorders,<sup>3,4</sup> general dissatisfaction<sup>5</sup> and dislocation.<sup>6</sup> One paper<sup>7</sup> in the orthopaedic literature suggests that LLD has no effect on the functional outcome of THA, but most surgeons perceive that it is important to address it by templating and to employ various methods of intra-operative equalisation of leg length.<sup>8-12</sup> The aim of this study was to assess the relative influence of LLD on the outcome of the arthroplasty by comparing the patients' perception of discrepancy and their Oxford hip score (OHS)<sup>13</sup> with their anatomical leg length. A secondary aim was to identify the site at which LLD was created at operation.

## Patients and Methods

We reviewed 90 patients who underwent unilateral THA between October 2002 and January 2003 clinically and radiologically. None had undergone previous surgery to the hip and all had no more than mild disease on the non-operated side.

We interviewed the patients before operation, after three months and at 12 months to obtain their OHS and their perception of leg length. By three months they were mobile enough to recognise LLD. At 12 months we were able to contact 75 patients, five others had died and ten were unavailable for questioning.

We measured the length of both legs on pre- and post-operative single, standard AP views

of the pelvis with the hips extended and internally rotated, as in previous studies.<sup>7,8,14,15</sup> This method has been reported to be as reliable as orthoroentgenograms<sup>15</sup> and reproducible, with a measurement error of  $\pm 1$  mm.<sup>7</sup> We used as reference points the inferior margin of the acetabular teardrop, the most prominent point of the lesser trochanter and the centre of rotation of the femoral head, measuring the distances between them to the nearest millimetre. This method does not take into account other discrepancies of length in the lower limb but does give an accurate assessment of the situation before and after surgery.

The operations were performed by 26 surgeons using two different approaches. We use five types of implant: collarless polished taper (CPT) (Zimmer, Swindon, UK); Exeter (Stryker, Howmedica Osteonics, Berks, UK); Charnley (DePuy Ltd, Leeds, UK); C stem (DePuy); initial proximal stability (IPS) (DePuy). Continuous data were analysed using Student's *t*-test and ordinal data by the chi-squared test.

## Results

**Leg length.** The majority (74 of 90; 82%) of limbs were lengthened in the course of THA. Before surgery, 18 (20%) patients had effective lengthening on the affected side, whereas 65 (71%) were short (mean 5.7 mm (-40 to 16 mm)) and eight (9%) were of equal length. Post-operatively, 56 (62%) patients had long (mean 9 mm), 5 (6%) equal and 29 (32%) short (mean -6.5 mm) limbs on the operated

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side with a mean lengthening of 3.5 mm (-22 to 27 mm) over the whole sample.

### Discrepancy and the Oxford hip score

In the 56 patients with increased LLD, 24 (43%) perceived this at three months post-operatively and 18 of 51 patients (35%) at 12 months. Patients who had increased LLD were significantly ( $p < 0.05$ ) more likely to detect LLD than those with short or equal leg lengths. In the 34 patients with short or equal lengths, 7 (21%) described LLD after three months and 4 of 24 (17%) described LLD after 12 months. After three months, the mean OHS of patients who perceived lengthening (24 out of 60) was significantly worse than patients who considered their operated leg to be of equal length or short (mean OHS 18 out of 60;  $p < 0.01$ ). After 12 months the mean OHS of the patients who perceived their leg to be long (20 out of 60) was still significantly worse than patients who felt it to be equal or short (15 out of 60;  $p < 0.05$ ). Equalising leg lengths would have reduced perceived lengthening after three months by 92% (18 of 20) and equalising within 5 mm by 75% (15 of 20). Two of the patients who perceived lengthening had either equal leg length or were 5 mm shorter. After 12 months equalising would have reduced perception of lengthening by 100% (14 of 14) and equalising within 5 mm by 84% (12 of 14).

The pre-operative OHS, age and gender were comparable between those who perceived LLD and those who did not.

**Position of implants.** On post-operative radiographs, the acetabular centre of rotation was high in 68 (76%) patients, anatomical in 4 (4%) and low in 18 (20%). There was no association between the centre of rotation and post-operative LLD. On the femoral side the position of the stem was associated with lengthening in 74 (82%) patients, anatomical in 3 (3%) and associated with shortening in 14 (15%). There was a highly significant association between lengthening and post-operative LLD ( $p < 0.001$ ). In 98% of patients (55 of 56) with true post-operative LLD the lengthening was related to the position of the femoral component.

**Operative differences.** There were significantly fewer long limbs using the CPT femoral component (20) than using the other four types of component (Exeter, 62; C stem, 3; Charnley, 3; and the IPS, 2), although the type of implant was not associated with any difference in the OHS.

Thirteen surgeons used the posterior approach in 56 patients and 13 the direct lateral in 34 patients. The mean LLD after the posterior approach was 1.2 mm (-22 to 19) and after the direct lateral 6 mm (-18 to 18;  $p = 0.01$ ). Templating made no significant difference to LLD. There was no difference in the OHS between the posterior and other approaches after 3 months ( $p = 0.1$ ) and after 12 months ( $p = 0.2$ ).

### Discussion

Discrepancy of leg length is common after arthroplasty of the hip. In the literature, the mean LLD varies from 1 to

15.9 mm.<sup>8-10,14-19</sup> LLD has been perceived in between 6%<sup>20</sup> and 32%<sup>19</sup> of patients and universally perceived when shortening exceeds 10 mm and lengthening 6 mm.<sup>14</sup> The pre-operative OHS is a significant predictor of the post-operative OHS.<sup>21</sup> Age and sex were comparable in patients who perceived LLD with those who did not. This suggests that LLD was the factor influencing the difference in post-operative OHS. The OHS improved between three and 12 months as described previously.<sup>21</sup> There is no evidence in the orthopaedic literature to support the contention that perception of LLD decreases with time. In our study, perception did not change over time in 86% of patients.

There has been only one previous attempt<sup>7</sup> to quantify the functional effects of LLD on the outcome of THA. The surgeon-based Harris hip score, the patient-based general health questionnaire, and the visual analogue pain score did not correlate with LLD. However, authors who used these systems of evaluation did not differentiate between lengthening and shortening and this may explain our contrasting conclusions.<sup>7</sup>

The number of surgeons involved in this study is representative of general orthopaedic practice. The Zimmer CPT stem was used by five different surgeons with different levels of experience. All these stems were implanted through the posterior approach, measuring thigh length intra-operatively, using the femoral broach and a trial head before implantation of the definitive prosthesis. This technique might explain the satisfactory performance of this prosthesis.

The OHS improved substantially after arthroplasty, but was 27% worse at three months and 18% worse at 12 months in patients who perceived true lengthening compared with those who perceived equal leg length. This suggests that avoiding lengthening would improve the outcome of THA. Our results suggest that correct positioning of the femoral component is most likely to achieve this.

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