Arthroplasty of the hip
LEG LENGTH IS NOT IMPORTANT
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Discrepancy in leg length after total hip replacement has been associated with patient dissatisfaction. We prospectively studied 200 consecutive patients undergoing unilateral Charnley hip replacements to identify whether there is a demonstrable association between such disparity and postoperative function. Radiological measurements between defined points on the pelvis and femur of the operated hip were compared with the same points on the contralateral joint. A lengthening index was derived and statistical analysis used to compare this with validated functional outcome scores (Harris hip score and the SF36 Health Survey) and patient satisfaction.

Our results showed no statistical association between leg-length discrepancy after hip arthroplasty and functional outcome or patient satisfaction.

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Discrepancy of leg length is often considered to be a problem after total hip replacement (THR), and has been associated with patient dissatisfaction. The pathophysiology of discomfort in such patients is multifactorial, although it is well recognised that nerve traction, such as may be related to lengthening of a limb at the time of THR, is a potential cause of nerve injury and subsequent pain. Likewise, excessive tension on the soft tissues around an implant may predispose to stiffness of the joint and heterotopic ossification.

The boundary between acceptable and unacceptable levels of disparity remains undefined. There have been reports in the American literature that leg lengthening of more than 2 cm, particularly in patients of short stature, is poorly tolerated, but these studies were of small numbers of patients and did not use validated outcome scores. The descriptions in the literature appear to confuse two distinct limb-lengthening situations after hip replacement. First, when a limb is short secondary to hip pathology and is restored to the same length as the opposite healthy limb, lengthening has taken place to restore the normal anatomy. In the second circumstance a limb may be lengthened beyond the normal anatomy so that the leg is longer than the contralateral limb. It is this situation which has most readily been cited as a cause of pain and functional and cosmetic problems and frequently results in litigation. As a consequence of the need to equalise leg length, several authors have sought to validate methods of minimising inequalities based on preoperative planning with radiological templates or intraoperative methods of measurement. Although in the UK there have been anecdotal reports of poor results after THR in which a leg has been lengthened, we could find no prospective study using objective, validated measures of hip function, quality-of-life and patient satisfaction. We therefore carried out a prospective study on patients undergoing THR.

Patients and Methods
Between January 1998 and 1999, 255 patients (272 hips) had THR with either the Charnley Monobloc (DePuy International Ltd, Leeds, England) or the modular Elite Plus (DePuy International Ltd) cemented hip system. The operation was carried out by one of seven orthopaedic surgeons, or directly under their supervision, using an anterolateral approach. Intraoperative assessment of leg length was done by clinical methods alone, and included evaluation of the soft-tissue balance and manual assessment of relative leg lengths as described by Charnley. No specialised techniques were used. All patients were examined before and at six months after operation by an audit nurse or physiotherapist. We excluded 55 patients (72 hips) because they had either had bilateral replacements within this period or had previously undergone contralateral THR, thus precluding the use of our measurement technique. Of the 200 remaining patients none refused consent or was lost to follow-up. In addition to clinical measurements of movement of the hip, the patients’ perceptions of their comfort, mobility and quality of life were assessed by the comple-
tion of both a joint-specific questionnaire, the Harris hip score (HHS)\textsuperscript{11} and a generic general health questionnaire, the Short Form 36 Health Questionnaire (SF36; Health Outcomes Trust, Boston, Massachusetts). These outcome measures have been validated and extensively used.\textsuperscript{12} The total HHS and its individual pain component were studied. The SF36 quantifies a patient’s perception of his or her quality of life, and has a total of ten ‘dimensions’ reflecting a range of physical and psychological parameters. Those addressing pain and physical function were assessed. The SF36 was considered to be a useful instrument because it not only provides a broader impression of health, but has been shown to correlate closely with the objective analysis of gait after THR.\textsuperscript{12} Satisfaction was assessed using a visual linear analogue scale, with patients asked to mark between zero (very dissatisfied) and ten (very satisfied) in reply to the question ‘How pleased are you with your total hip replacement?’

The degree of lengthening of a leg was assessed radiologically using the method of Woolson et al\textsuperscript{6} (Fig. 1). Routine postoperative radiographs were taken, with maximum internal rotation of both hips in extension. A consistently reproducible reference point on the pelvis was obtained by drawing a line transversely through the inferior borders of the two teardrops. The lesser trochanter was taken as the corresponding reference point on the femora and, in order to neutralise the potential problem of femoral rotation, the most medial tip of this prominence was selected. A line was drawn from the femoral reference point to a perpendicular intersection with the pelvic reference line.
This distance (X) was taken as the index of postoperative leg length. The distance (Y) of the contralateral limb was assumed to be equal to the initial length of the operated limb before the development of the arthritic deformity and subsequent surgery. None of the patients in the study had anatomical anomalies such as developmental dysplasia, coxa vara, major arthritic change, acetabular erosion or collapse of the femoral head in the contralateral hip. The degree of lengthening or shortening obtained during arthroplasty was expressed as the ratio between the two limbs. All measurements were made by one investigator (TOW) who was blind to the functional outcome. A sample of radiographs were re-measured on several occasions by the same researcher, without reference to the previous results, giving a measurement error of ± 1 mm. This technique has been previously validated and found to correlate closely with plain radiological scanograms.

The ratio of leg lengths was tested for correlation with each of the five outcome measures using the Spearman rank correlation coefficient.

In the patients who had been most lengthened or shortened, we calculated the exact difference in postoperative lengths. This was achieved by measuring the diameter of the head of the prosthesis on the radiograph. By dividing this by the true diameter of the femoral head (22.25 mm) the degree of radiological magnification was calculated, allowing the true lengths to be derived. The mean radiological magnification was 1.2 (1.1 to 1.3).

Results

There was no statistical association between leg-length ratio and any of the outcome measures as assessed by the HHS, SF36 scores or patient satisfaction six months after operation. Figures 2 and 3 show plots of the leg-length ratio against the HHS, its pain component, and the SF36 pain and physical function components, respectively, at six months as well as the associated p value for correlation. A ratio of 1.0 indicates exact parity between leg lengths.

There is no correlation between any of these outcome measures and the leg-length ratio. Patient satisfaction was not associated with leg-length discrepancy (Spearman rank correlation coefficient, +0.09, p = 0.25). When the type of prosthesis was compared, there was no significant difference in the SF36 pain or function scores or in the HHS or satisfaction scores.

Overall, 143 THRs were within 10 mm of being the same length as the contralateral hip. In 16 patients shortening was by more than 10 mm (-11 to -20 mm) and in 41 lengthening was by more than 10 mm (37, +11 to +20 mm; 3, +21 to +30 mm; 1, 35 mm). A slightly higher proportion of the Monobloc stems were within 10 mm of the contralateral hip (88/116, 76%) than were the modular stems (55/84, 65%).

Discussion

Our study shows that radiological lengthening (+35 mm) or shortening (+21 mm) during THR does not correlate with function, comfort or satisfaction six months after operation. The outcome after THR is usually described in terms of the rates of loosening and failure. The technical aspects of the design of the implant and positioning are clearly important, and in everyday practice considerable significance is placed on the postoperative radiological appearance of the prosthesis. By contrast, however, detailed assessments of satisfaction, comfort and function after operation are rare. We are not aware of any previous studies using validated functional and satisfaction outcome measures in the assessment of leg-length discrepancy.

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