There are several techniques for the accurate measurement of the migration of components after arthroplasty, some of which require the operative placement of tantalum balls. We have reviewed the position and migration of these markers in 64 patients after total hip arthroplasty.

In 40% of cases, one or more balls was seen to be outside the proximal femur on the postoperative radiograph, although all were considered to be within the bone at operation. In two hips, one ball appeared to have migrated towards the joint, although none was seen within the joint. Misplacement was not related to the experience of the surgeon or the operative approach.

Migration analysis which necessitates the insertion of tantalum balls requires careful technique to avoid a potential source of third-body wear. It should probably be used only for research in small series of patients.

RSA is expensive and time-consuming and requires the placement of a number of tantalum ball markers. Any which dislodge from bone are a potential cause of third-body wear of the joint.

We have made a radiological review of the position and migration of such tantalum balls after total hip arthroplasty.

Patients and Methods

A total of 64 patients had 64 hip replacements during a randomised, controlled trial of two cemented femoral prostheses. Tantalum balls, 0.8 mm in diameter, were inserted into the proximal femur using a custom-designed introduction system (Orthodesign Ltd, Dorset, UK). We used roentgen monophotogrammetric analysis (RMA), as described by Klaassens to assess the migration of the femoral components. This requires the operative placement of at least three tantalum marker balls within the proximal femur in the same coronal plane (Fig. 1). We inserted a median number of four balls (2 to 8) in our cases, with informed consent from all patients.

Standard radiographs were taken after operation and at follow-up visits. There were 64 sets of postoperative radiographs and 50 follow-up sets.

Each radiograph was studied to determine the number of balls, their position and their adequacy for RMA. We defined ball position as intraosseous, periosseous or extraosseous. RSA, using tantalum bone markers, allows the accurate detection and measurement of movement between the prostheses and bone. The accurate measurement of the migration of a relatively small number of prostheses over a short period of time may well give predictive information much earlier than survival analysis of large numbers over long periods. It has been suggested that all new designs of prosthesis should be evaluated by this method.

Results

In six hips RMA was not possible because of inadequate position of the balls (3) or too few of them (3).

In 38 of the 64 cases (60%) all the balls appeared to be within bone on postoperative films. There were 21 peri-osseous balls in 18 hips and 15 lay extraosseous in 15 hips. In 12 of the 18 patients with peri-osseous balls there were follow-up radiographs; one of the 14 peri-osseous markers in these hips had migrated. In two hips extraosseous balls,
Fig. 1
Marker balls for RMA, inserted in one coronal plane, medial and lateral to the prosthesis.

Fig. 2a
A marker ball above the tip of the greater trochanter (a), has apparently migrated medially towards the joint (b).

Fig. 2b
An immediate postoperative radiograph (a). After three months, a marker ball is seen below the inferior tip of the acetabular prosthesis (b).

Fig. 3a
Fig. 3b
placed initially in the region of the greater trochanter, had migrated towards the artificial joint space (Fig. 2) although none had entered it.

The omega approach to the hip, had been used in 43 patients, a posterior approach in 18 and the modified anterolateral approach of Dall in three. The operating surgeon was a consultant at 32 operations, a senior registrar at 18 and a registrar at 14; the position and number of balls for each group are shown in Table I. We found no significant correlation between the grade of surgeon or the
approach used and poor placement of the balls, using the chi-squared test.

Discussion

There are many techniques other than RSA, with an accuracy of 0.2 mm, for the measurement of migration in hip and knee components.\textsuperscript{11-14} Some require the insertion of bone markers, and have been shown to measure prosthetic displacement of as little as 1 mm.\textsuperscript{15} Walker et al\textsuperscript{14} have claimed accuracy similar to that of RSA for axial migration, but rotation or translation in other planes was not assessed.

The method which we have used produced marker balls apparently outside the bone on postoperative radiographs in 40\% of hips, and this was not clearly related to the surgeon’s experience or the operative approach.

There are many reports on the migration of small metal objects in the body,\textsuperscript{16-18} one of which reported the finding of a screw from a femoral plate within the knee after 22 years.\textsuperscript{19} We found migration of one periosseous and two extraosseous balls within three months, and although none had entered the joint space, there is clearly a potential for third-body wear.

One possibility is that the insertion device which we used was faulty. We therefore reviewed the radiographs of another 13 patients, in whom the marker balls had been inserted during hip replacement with a spring-loaded gun of the type used in Sweden for RSA. At the five-year follow-up, 43 balls were seen in the 13 patients. Two periosseous and two extraosseous balls were seen in four patients, and three of them had migrated, one into an intracapsular position next to the acetabular component (Fig. 3). Other users of marker-ball insertion (Ryd, personal communication) and other radiographs shown at scientific meetings have confirmed that our experience is not uncommon.

The accurate measurement of early prosthetic migration seems to be a useful predictive tool, but methods which require the insertion of tantalum balls are expensive and time-consuming, and have been shown to introduce a potential complication. This makes other methods more attractive for large trials and routine follow-up. RSA and RMA should probably be reserved for the evaluation of new prosthetic designs in small numbers of patients, with considerable care taken to ensure accurate insertion of markers well into bone.

The authors thank Mr Ackroyd, Mr Smith and Mr Winson for allowing us to review their patients’ radiographs.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References

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