In-cement technique for revision hip arthroplasty

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The in-cement technique for revision hip arthroplasty involves retaining the original cement-bone interface. This has been proven to be a biomechanically stronger method than recementing after complete removal of the original cement mantle.

This study reviewed a series of 54 consecutive revision hip arthroplasty procedures, using the in-cement technique, between November 1999 and November 2003. Clinical and radiological follow-up included functional assessment.

There were 54 procedures performed in 51 patients, whose mean age at surgery was 70.3 years (45 to 85). A total of 42 were available at a mean follow-up of 29.2 months (6 to 51). There was no radiological evidence of loosening. Functional assessments were available for 40 patients who had a mean Harris hip score of 85.2 (51.9 to 98.5), a mean Oxford hip score of 19.6 (12 to 41), a mean UCLA activity profile score of 5.9 (3 to 8) and a mean SF-36 score of 78.0 (31.6 to 100).

The in-cement technique provides consistent, high functional outcomes and should be considered in appropriately selected cases.

Revision of the femoral component of a total hip arthroplasty (THA) poses significant technical challenges and involves a number of complications such as fracture of the femur and bone perforation,¹ which can occur in up to 21% of cases.² Up to 11.4% of primary total hip arthroplasties need revision within the first ten years³ and revised arthroplasties have a ten-year failure rate of 26%.³ Nabors et al⁴ described differing methods and time-scales for loosening of the femoral and acetabular components. Revision arthroplasty often involves tackling a loose acetabular component in the presence of a well-fixed femoral component.

Removal of the entire cement mantle is well described^{1,3,5} but it adds to the time taken and to the complications of the revision procedure. Dohmae et al⁶ demonstrated that the shear strength of the cement-bone interface at revision surgery is only 20.6% of that seen after the primary procedure, whilst at a second revision it is only 6.8%. This was later supported by Rosenstein et al⁷ who showed that the shear strength of a revised cement-bone interface was 30% weaker than that of a primary interface.

Several methods of extraction of the cement mantle have been described.^{8,9} In 1978, Eftekhari¹⁰ described the 'in-cement'

technique for revision surgery. This involves 'freshening up' the existing cement mantle with a burr prior to recementing. This technique was validated by the biomechanical work of Greenwald, Narten and Wilde,¹¹ which showed minimal loss of shear strength. However, Li et al⁵ described a reduction in the bond between the existing cement and the new interface of 80% to 85% in the presence of a thin layer of blood and marrow debris. If suitable attention is given to the preparation and drying of the existing mantle, good results can be achieved, as shown by the 15 cases reported by McCallum and Hozack.¹²

The in-cement technique is indicated in a variety of revision arthroplasty situations, including surgery for a broken component with intact distal mantle, removal of a femoral component to improve exposure of the acetabulum, and recurrent dislocation secondary to component malposition.¹³

This technique can also be employed for the conversion of a cemented hemiarthroplasty to a THA and, in exceptional circumstances, in the presence of infection where there is complete osseointegration of the femoral cement-bone interface.

We have reviewed our experience using this technique in revision THA.

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Fig. 1a

Fig. 1b

a) Pre-operative and, b) post-operative radiographs of a 62-year-old man who underwent revision for recurrent dislocation.

Patients and Methods

A consecutive series of 51 patients (31 men and 20 women) underwent a total of 54 in-cement procedures between November 1999 and November 2003.

The patients were assessed for their suitability pre-operatively using plain radiographs. Other revision techniques were employed if there was osteolysis around the femoral component.

All of the patients had spinal anaesthesia, and a posterior approach to the hip was used. The hip was dislocated and the femoral prosthesis removed, allowing optimal access to the acetabulum. The removal of the cement from around the shoulder of the femoral component allowed safe and easy removal of the component, as well as access to areas of osteolysis within the greater trochanter. This area corresponds to zone 1, as described by Gruen, McNiece and Amstutz.¹⁴ The proximal cement was removed using a burr, to a depth where osseointegration of the cement-bone interface was confirmed.

The well-fixed distal cement mantle was then thoroughly debrided using pulsed lavage and prepared using the Midas-Rex high-speed burr (Medtronic Inc., Fort Worth, Texas) creating a freshened cavity within the old cement mantle. A double mix of Simplex cement (Stryker Howmedica Osteonics, Mahwah, New Jersey) was prepared in a vacuum-mixed bowl and, while still in a low state of viscosity, was inserted into the femur using a gun with a thin nozzle (Stryker Howmedica Osteonics). Suction and pressure techniques were employed to ensure that maximal cement pressurisation was achieved. Following this, the new femoral component was inserted (Fig. 1).

All patients were assessed clinically and radiologically at six weeks, three months, six months, one year and 18 months post-operatively and then annually for a maximum of four years after surgery. Clinical assessment included a Harris hip score,¹⁵ and Oxford hip score questionnaire,¹⁶ a University of California at Los Angeles (UCLA) activity profile¹⁷ and an SF-36 questionnaire.¹⁸

Results

Of the 51 patients treated, at final assessment nine had died. All the remaining 42 patients (45 procedures) were available for follow-up. The mean age at revision was 70.3 years (45 to 85). The mean follow-up period was 29.2 months (6 to 51) and the mean time to revision from the primary procedure was 132 months (26 to 286).

Of the original 54 procedures, 29 were performed on the right hip and 25 on the left. The indications for revision included aseptic acetabular loosening in 43 patients, aseptic proximal femoral loosening with a broken femoral component in three, recurrent dislocation in three, infection in three, a broken acetabular component in one and intractable pain in one patient.

The acetabular component was revised in 53 of the 54 cases, 24 with allograft and 11 with autograft. The remaining 18 acetabular components were replaced without grafting.

An Exeter femoral component (Stryker Howmedica Osteonics) was used in 53 procedures and in one the Howse component (Johnson and Johnson, Leeds, United Kingdom) that was removed was re-implanted.

At final follow-up, there was no evidence of clinical or radiological failure in any of the patients.

There were two patients who were unable to complete the hip score questionnaires and activity profile owing to associated musculoskeletal pathology. They were however, followed up radiologically. The following functional results are based on the 40 patients at final assessment who could complete the questionnaires. The mean Harris Hip score for the group was 85.2 (51.9 to 98.5) which is classified as a good result. The mean Oxford hip score was 19.6 (12 to 41). Seven patients recorded a best possible total of 12, while any score between 12 and 20, on a scale of 12 to 60 indicates satisfactory joint function. The mean UCLA activity profile score was 5.9 (3 to 8). A score of six equates to participating regularly in moderate activities (swimming, housework, shopping). There was one patient unable to comply with the SF-36 questionnaire because of Alzheimer's disease. The mean SF-36 score was 78.0 (31.6 to 100) which was made up of a mean physical score of 73.3 (20.5 to 100) and a mental result of 82.7 (14.8 to 100).

Discussion

Revision hip arthroplasty has a poorer outcome than primary arthroplasty,¹⁹ due to the older age of the patients and technical difficulties. Revision of the femoral component, in particular, has significant complications.² The in-cement technique allows for a reduction in these complications as well as reducing the length of the operation.

This series of 54 revisions in 51 patients of whom 42 (45 procedures) were available for follow-up shows excellent functional outcome in an elderly group whose mean time from primary arthroplasty to revision was 132 months. While the mean follow-up period of 29.2 months is rela-

tively short, it compares favourably with that of other series,¹² and is of sufficient length to demonstrate excellent results in a group of revision patients with a mean age of more than 70 years.

In this series, the in-cement technique was only used in patients who had an intact cement mantle in the distal femur. We assessed this both pre-operatively, from plain radiographs, and intra-operatively. In the majority of cases, the femoral component was removed in order to improve access to the acetabulum. This technique is of particular value when grafting techniques are used in acetabular revision, as was the case in 35 of 51 patients in this series.

Pre-operative templating was employed and the existing cement mantle was burred to accommodate the femoral component and ensure its anatomical placement. Several authors²⁰⁻²² have described increased failure rates associated with poor placement of the femoral component. The removal of the loose cement from Gruen zone 1¹⁴ allows clear visualisation of the rest of the cement mantle, as well as allowing better access to the femoral canal. In the cases of the three broken femoral components, the breakages occurred at the junction between the well-fixed distal cement and loose proximal cement, making these patients ideal for the in-cement revision technique.

The functional results of this series also compare favourably with the similar but smaller series published by McCallum and Hozack¹² and Lieberman et al.¹³ Because the mean age of patients undergoing primary hip arthroplasty is becoming less, those undergoing revision procedures are also younger. The functional outcomes in this series must be considered in the context of the older mean age of the patients. The functional hip scores in this group with a mean age of 70.3 years can carry out all activities of daily living after revision hip arthroplasty.

The shortened operative time may minimise the incidence of peri-operative complications.

When the Norwegian Arthroplasty Registry figures of 11.4% revision rate at ten years following primary hip arthroplasty are considered,³ it emphasises the magnitude of the challenge presented by revision surgery. We strongly suggest that the in-cement technique should be considered for appropriate cases, as this technique offers a relatively safe and repeatable method of optimal exposure of all aspects of the acetabulum.

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