Ann R Coll Surg Engl 1994; 76: 396–400

Current attitudes to cementing techniques in British hip surgery

Aresh Hashemi-Nejad FRCS
Orthopaedic Senior Registrar

Nicholas J Goddard FRCS
Orthopaedic Consultant

Nicholas C Birch FRCS
Orthopaedic Senior Registrar

Orthopaedic Department, The Royal Free Hospital NHS Trust, London

Key words: Hip surgery; Cementing technique; Prostheses

Aseptic loosening is the major problem in hip joint replacement. Improved cementing techniques have been shown to improve the long-term survival of implants significantly. To assess the use of modern cementing techniques in British surgeons, a detailed questionnaire was sent to all Fellows of The British Orthopaedic Association (BOA) regarding cement preparation, bone preparation, cementing technique and prostheses used in total hip arthroplasty.

Excluding retired fellows, surgeons who use no cement, and those who had filled in forms inadequately, 668 responded, who between them performed 43 680 hip arthroplasties per year. In this survey, 21 different types of hip prostheses were implanted by the surgeons; 48% of hips implanted were Charnley type. Of the surgeons, 46% used Palacos with gentamicin as their cement for both the femur and acetabulum.

For the femur, 44% of surgeons remove all cancellous bone, 40% use pulse lavage, 59% use a brush to clear debris, 94% dry the femur, 97% plug the femur, 76% use a cement gun and 70% pressurise the cement. For the acetabulum, 88% of surgeons retain the subchondral bone, 40% use pulse lavage, 100% dry the acetabulum, 22% use hypotensive anaesthesia and 58% pressurise the cement.

Overall only 25% of surgeons (26% of hips implanted) use 'modern' cementing techniques. This has implications for the number of arthroplasties that may require early revision.

Correspondence to: Aresh Hashemi-Nejad FRCS, Orthopaedic Department, The Royal Free Hospital NHS Trust, Pond Street, London NW3 2QG

Total hip arthroplasty (THA) is one of the most successful and cost-effective operations ever introduced, and annually 800 000 THAs are done worldwide. Aseptic loosening of the components is the most common long-term complication and constitutes 80% of the revisions *(1)*.

Using cementing techniques initially advocated by Charnley (first generation) the incidence of radiographic loosening of the femoral component was reported to be 30% to 40% at 10 years *(2,3)*. Using improved cementing techniques with intramedullary bone plugs, cement gun and pressurisation (second generation), the incidence of radiographically loose femoral components fell to 3% at 11 years *(4)*. Comparison of patients undergoing THAs using only a cement gun with improved cementing techniques in a single centre showed a reduction of radiological loosening from 21% at a mean of 4 years in the first group to no loosening in the group having the improved cementing technique *(5)*.

De Lee and Charnley *(6)* reported a 9% cup migration rate which was associated with a thin acetabular wall. Fowler *et al.* *(7)* using a technique that pressurised cement on to clean cancellous bone demonstrated significant reduction in cup migration at 7 and 13 year reviews. Mulroy and Harris *(4)* showed no change in the incidence of radiographically loose acetabulum using their improved cementing techniques.

We undertook a study to review the current attitudes to cementing technique in British hip surgery.

Method

To assess the cementing practice of British Orthopaedic Surgeons for primary hip replacement, we posted a questionnaire (Fig. 1) to all 1084 Fellows of The British Orthopaedic Association. The questionnaire was in four

FEMORAL CEMENTING TECHNIQUES

1. Do you attempt to remove as much cancellous bone as possible? Y N
2. Do you use pulsed lavage? Y N
3. Do you use an intra-medullary brush to clear bone debris? Y N
4. Do you dry the femoral shaft prior to cementing? Y N
   If 'yes' please ring or specify your usual technique
   - —Plug
   - —Swab
   - —Swab + adrenaline
   - —Other?
5. Do you plug the distal femur? Y N
   If 'yes' please ring or specify your usual technique
   - —Cancellous bone plug
   - —Cement
   - —HDP (eg. Hardinge, JRI)
   - —Other
6. Do you use a cement gun? Y N
7. Do you pressurize the cement prior to insertion of the prosthesis? Y N
8. What is your usual femoral component?
   Please specify:
9. What head size do you generally use?
   Please ring or specify
   - —22.25 mm
   - —25 mm
   - —28 mm
   - —29 mm
   - —32 mm
   - —Other

   Approximately how many cemented replacements are done in your name per annum?

ACETABULAR CEMENTING TECHNIQUES

1. Do you aim to retain the subchondral bone? Y N
2. Do you use anchor holes? Y N
   - —"Classical" large ilial, ischial + pubic Y N
   - —Multiple small anchor holes Y N
   - —Other
3. Do you use pulsed lavage? Y N
4. Do you dry the acetabulum prior to cementing? Y N
   Please ring or specify your technique:
   - —Swab
   - —Swab + adrenaline
   - —Other
5. Do you use controlled hypotension prior to cementing? Y N
6. Do you pressurize the cement prior to insertion of the socket? Y N

CEMENT PREPARATION

1. Which cement do you usually use for:

The femur?	The acetabulum?
—CMW	—CMW
—Simplex	—Simplex
—Palacos	—Palacos
—Palacos + Gentamicin	—Palacos + Gentamicin
—Other?	—Other?

2. Do you use low viscosity cement? Y N
   - —Acetabulum Y N
   - —Femur Y N
3. Do you chill the monomer? Y N
4. Do you centrifuge the cement prior to insertion? Y N
5. Do you vacuum mix the cement? (Not simple fume extraction) Y N

Figure 1. Questionnaire.

parts regarding: (1) The prosthesis used; (2) The cement and its preparation, (3) Femoral canal preparation and cementing technique and (4) Acetabular preparation and cementing technique.

Results

A total of 719 surgeons responded to the survey. Excluding retired fellows, surgeons who use no cement, and those who had filled in forms inadequately, 668 responded, who between them performed 43 680 hip arthroplasties per year (an average of 65 hips per surgeon per year (range 10–250)). Excluding retired fellows and those who do no hips from the non-responding group, the survey is representative of 70% of all BOA Fellows performing hip arthroplasty. The results of the questionnaire were analysed with respect to the number of surgeons performing the technique and number of hips which underwent a particular practice.

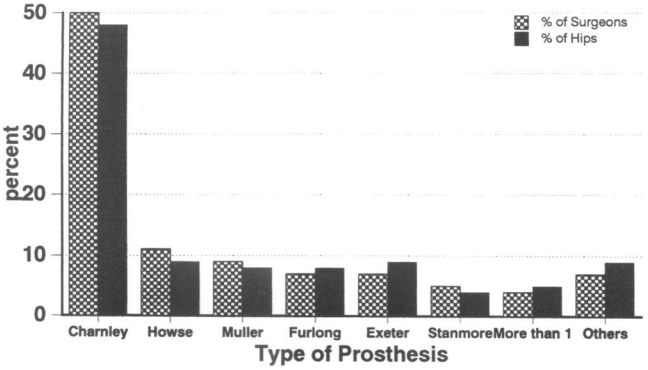

Figure 2. Prostheses used.

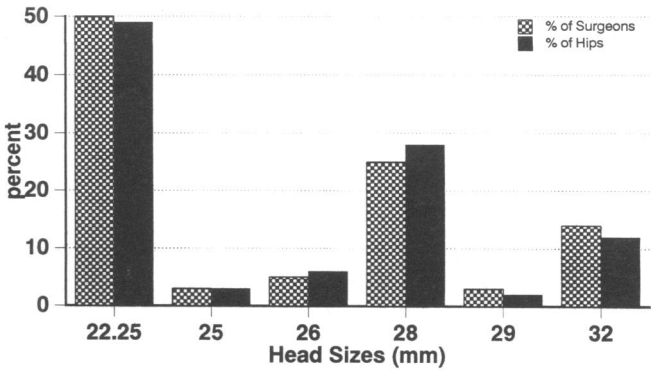

Figure 3. Head sizes used.

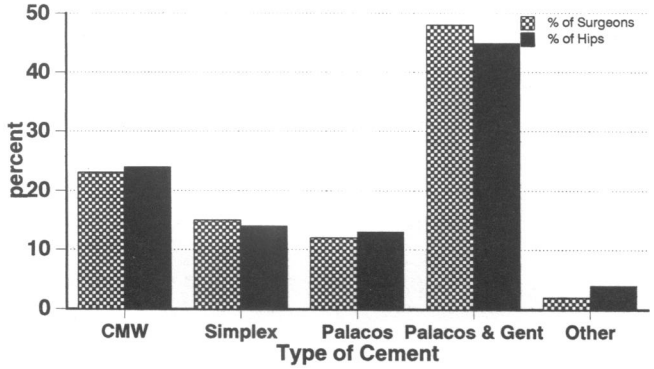

Figure 4. Femoral cement used.

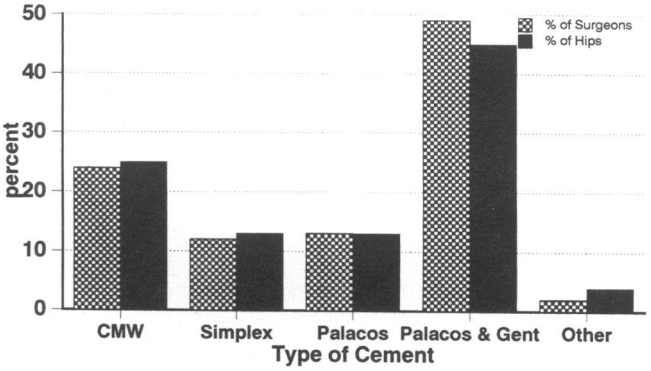

Figure 5. Acetabular cement used.

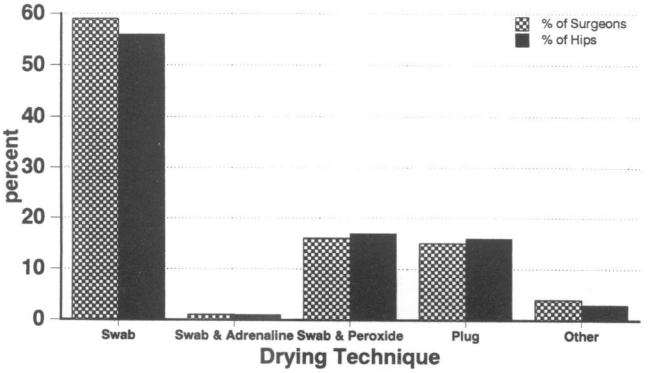

Figure 6. Femoral drying technique.

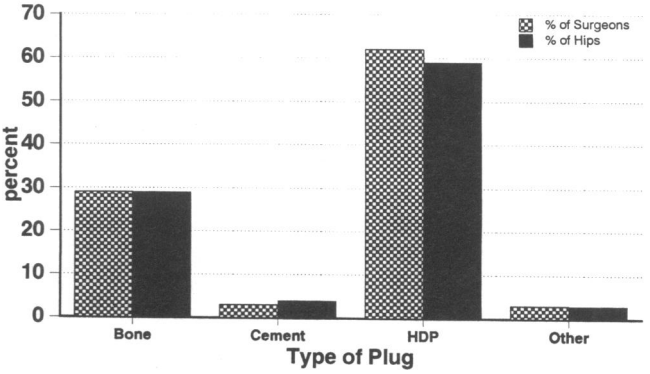

Figure 7. Femoral distal plug.

Prostheses used

There were 21 different types of hip being used by the surgeons. Charnley types were used by 50% of surgeons and accounted for 48% of hips implanted (Fig. 2). Of the surgeons, 4% used more than one type of hip. Of hips implanted, 49% had 22.25 mm heads and 28% had 28 mm heads (Fig. 3).

Cement preparation

Of the surgeons, 6% chilled the monomer, 11% vacuum mixed and 2% centrifuged the cement. In the femur, 26% of surgeons used low-viscosity cement and in the acetabulum 7%. Palacos with gentamicin was used by 49% of surgeons in the femur and by 45% in the acetabulum (Fig. 4 and Fig. 5).

Femoral technique

Of the surgeons, 44% aim to remove the cancellous bone, 40% use pulse lavage, and 59% use a brush to clear the debris; 94% of surgeons dry the femur (Fig. 6), most commonly using a swab; 97% plug the distal femur (Fig. 7), most commonly using a high density polyethylene implant; 76% use a cement gun and 70% pressurise the cement.

Acetabular technique

The subchondral bone was retained by 88% of surgeons (in 82% of hips implanted). All surgeons use anchor holes (Fig. 8) and all dry the acetabulum (Fig. 9); 40% of surgeons use pulse lavage and 23% use hypotensive anaesthesia; 58% pressurise the cement in the acetabulum.

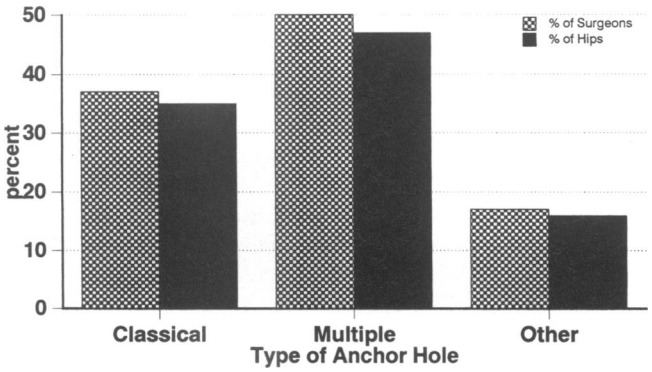

Figure 8. Acetabular anchor holes.

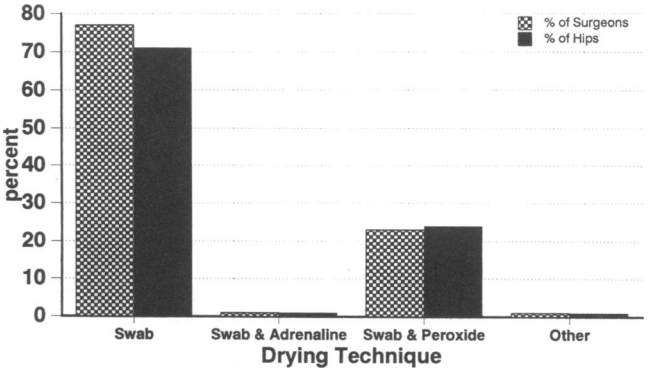

Figure 9. Acetabular drying technique.

Discussion

There is no great variation in the numbers of hips implanted in a particular way and the numbers of surgeons performing the different techniques. The number of THAs performed per surgeon per year reported in this study seems a little high, and although the numbers reported may have been exaggerated we feel the techniques reported are not.

There is a wide range of hip prostheses available to the surgeon, many of which have no long-term outcome studies. There are 21 types of hip implanted by the surgeons in this study, 86% of the hips implanted are Charnley, Howse, Müller, Furlong, Exeter and Stanmore types. The wide variation of prosthesis used has been reported previously *(8)*, but not the frequency with which they are used. Of the surgeons, 50% implant Charnley type hips, which account for 48% of hips implanted; 7% of surgeons implant Exeter type hips which account for 9% of hips implanted; 4% of surgeons use more than one type of hip as their choice of implant. In the absence of long-term comparative prospective trials it is difficult to know if one prosthesis is better than the other.

The biological consequences of particulate wear debris are a cause for concern. Livermore *et al. (9)* showed that the greatest amount and linear wear occurred with a 22.25 mm head, the greatest amount and volumetric wear was seen in the 32 mm head and the least amount and linear wear were associated with the use of a 28 mm head diameter, suggesting the best wear characteristics are realised with a mid-range head size. Morrey and Ilstrup *(10)* demonstrated a higher incidence of acetabular loosening with the 32 mm head size compared with the 22.25 mm component, which has a smaller frictional torque force. This survey showed that 50% of hips implanted are with a 22.25 mm head. This is a reflection of the high number of Charnley types implanted. Only 25% of surgeons (28% of hips) implanted 28 mm heads.

The Wrightington group and others still use Charnley's original cementing technique and have indeed reported very low femoral stem loosening rates even at 20 years *(11,12)*; however, much data supports the concept that substantially more surgeons can achieve an excellent mantle of cement about the femoral component by using modern cementing techniques *(13)*. These modern (third generation) techniques include the use of a medullary plug, use of a cement gun, cleaning of the intertrabecular spaces (using a brush and pulse lavage), pressurisation and reduction of the porosity of the cement *(14)*. For the acetabulum, pressurisation of cement on to clean cancellous bone demonstrated significant reduction in cup migration *(7)*.

Excluding the centrifugation of cement, which is only performed by 2% of the surgeons in this survey, only 25% of surgeons (26% of hips implanted) perform these modern 'third generation' cementing techniques. We did note that surgeons who implanted 20 or less hips per year had different cementing practice to those who implanted more. Only six out of 105 surgeons in this group undertook modern cementing techniques. This has implications on the potential number of early failures due to aseptic loosening. We feel the emphasis in hip surgery should move from implanting new designs to improving the cementing techniques on tried and tested prostheses.

References

1 Malchau H, Herberts P, Ahnfelt LE, Johnell O. Prognosis of total hip replacement. Results from the national register of revised failures 1979–1990 in Sweden—a ten year follow-up study of 92 675 THR. Scientific Exhibition presented at the 61st American Academy of Orthopaedic Surgeons, 1993.

2 Stauffer RN. Ten year follow up study of total hip replacement with particular reference to roentgenographic loosening of the components. *J Bone Joint Surg* 1982; **64A**: 983–90.

3 Sutherland CJ, Wilde AH, Borden LS, Marks KE. A ten year follow up of one hundred consecutive Müller curve stem total hip replacement arthroplasties. *J Bone Joint Surg* 1982; **64A**: 970–82.

4 Mulroy RD, Harris WH. The effect of improved cementing techniques on component loosening in total hip replacement. *J Bone Joint Surg* 1990; **72B**: 757–60.

5 Roberts DW, Poss R, Kelley K. Radiographic comparison of cementing techniques in total hip arthroplasty. *J Arthroplasty* 1986; **1**: 241–7.

6 De Lee JG, Charnley J. Radiological demarcation of cemented sockets in total hip replacement. *Clin Orthop* 1976; **121**: 20–32.

7 Fowler JL, Gie GA, Lee AJC, Ling RSM. Experience with the Exeter total hip replacement. *Orthop Clin North Am* 1988; **19**: 477–89.

8 Newman K. Total hip and knee replacements: a survey of 261 hospitals in England. *J R Soc Med* 1993; **86**: 527–52.

9 Livermore J, Ilstrup D, Morrey B. Effect of femoral head size on wear of the polyethylene acetabular component. *J Bone Joint Surg* 1990; **72A**: 518.

10 Morrey B, Ilstrup D. Size of the femoral head and acetabular revision in total hip replacement arthroplasty. *J Bone Joint Surg* 1989; **71A**: 50.

11 Joshi AB, Porter ML, Trail IA *et al.* Long-term results of Charnley low friction arthroplasty in young patients. *J Bone Joint Surg* 1993; **75B**: 616–23.

12 Schulte KR, Callaghan JJ, Kelley SS, Johnston RC. The outcome of Charnley total hip arthroplasty with cement after a minimum twenty year follow-up. The result of one surgeon. *J Bone Joint Surg* 1993; **75A**: 961–75.

13 Harris WH. One step back, two steps forward. *J Bone Joint Surg* 1993; **75A**: 959–60.

14 Harris WH, Davies JP. Modern use of modern cement for total hip replacement. *Orthop Clin North Am* 1988; **19**: 581–9.

Received 7 March 1994