Femoral cementing techniques: current trends in the UK

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ABSTRACT

INTRODUCTION The results of a survey conducted amongst hip surgeons in Great Britain on the use of bone cement and femoral cementing techniques are reported.

MATERIALS AND METHODS A postal questionnaire was sent out to the members of the British Orthopaedic Association for their opinion on cement usage and femoral cementing techniques in primary hip arthroplasty.

RESULTS A majority of surgeons use high viscosity cement (82%) and cement containing antibiotics (77%). Almost a fifth of the respondents were unaware of the place of storage of the cement and of the ambient theatre temperature. Over two-thirds experienced inconsistencies in the handling of cement and attributed this to inconsistent theatre temperature (40%) and storage temperature (14%). A majority of the surgeons followed the 'modern' femoral cementing technique of vacuum mixing (94%), plugging the femoral canal (98%), pulsed lavage (87%), retrograde cement introduction (95%), use of stem centralisers (62%) and cement pressurisation. Four-fifths of the surgeons used time as a guide for cement and stem insertion rather than consistency of the cement.

CONCLUSIONS Though most of the surgeons follow contemporary cementing techniques, it appears that inconsistency of the working properties of the cement is a major impediment. Many surgeons are also unaware of the variables that can influence polymerisation and working time of the cement.

KEYWORDS

Bone cements – Cementation – Hip replacement

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Bone cement remains the commonest form of fixation of the components at total hip arthroplasty. The basic chemical structure remains unaltered, but modifications in its formulation have made it a versatile product. The surgeon now has a wide range of products to choose from. Nevertheless, inconsistency of the handling properties of cement continues to challenge surgeons and manufacturers alike. The sensitivity of cement polymerisation to temperature is a well-known confounding variable.¹ It is important to understand the variables influencing the handling properties of cement. Femoral cementing techniques have evolved with time. Clinical data comparing the 'old' and 'modern' techniques have not always shown one technique to be better than the other.² This may be partially responsible for the reluctance of many surgeons to embrace the modern cementing technique.^{3,4} This paper reports on a survey conducted to establish current

cementing techniques practised in Great Britain and evaluate surgeons' awareness of the factors that influence the handling properties of cement.

Materials and Methods

A questionnaire was sent out to members of the British Orthopaedic Association requesting information about the type of cement used, the place of storage, the reliability of a constant storage temperature, the theatre temperature, the inconsistencies in the handling properties of the cement and the technique of femoral cementation that they practised.

Results

A total of 1620 questionnaires were sent out and 762 (47%) completed responses were received. Of these, 587 (77%)

were from surgeons who routinely performed hip replacements. The remaining 175 (23%) were surgeons who did not perform hip replacements. Of the 587 respondents who performed hip replacements, 19 (3%) indicated that they performed uncemented replacements exclusively and were, therefore, excluded from the study. The final study group, therefore, comprised 568 respondents.

Of the surgeons, 42% took a special interest in total hip replacements. The annual number of arthroplasties performed by the surgeons is shown in Figure 1.

The cement

A majority of surgeons (77%) used antibiotic-containing cement. High-viscosity cement was used by 82% of the surgeons, medium-viscosity cement by 12% while 6% used low-viscosity cement. Palacos-R with gentamicin was the most commonly used cement (59%). The other brands of cement used included Palacos-R (11%), Antibiotic Simplex (8%), CMW-Gentamicin (6%), Palacos-LV and Surgical Simplex (4% each) CMW1 (3%) and others (3%). Of the respondents, 99% did not add additional antibiotics to the cement.

Storage of cement

Some 245 (43%) respondents said that the cement was stored either in the theatre or in a store at theatre temperature, 35% (196) said that it was stored at a temperature different from that of the theatre, 21% (121) indicated that they were unaware of the place of storage while 1% (5) said that the cement was stored elsewhere. The detail of the temperatures at which the cement was stored outside the theatre is given in Figure 2.

When cement was stored at temperatures different from that of the theatre ($n = 317$), only 22% felt that this temperature was constant. When the cement was stored at theatre temperature ($n = 245$), only 35% thought that the temperature was constant.

Theatre temperature

Figure 3 represents the data for theatre temperature. Of the 447 respondents who were aware of the theatre temperature, 52% (231) were certain that it was constant, whereas 39% (176) felt that it was not constant. The rest were unaware whether it was constant or not.

Figure 4 Causes of inconsistency in cement behaviour.

Inconsistency of cement

Of the surgeons, 68% experienced inconsistencies in the setting time of cement; 12% said that the cement set early, 14% felt that it set late and 74% had experienced both these problems. Figure 4 illustrates the probable reasons for the erratic behaviour of cement offered by the respondents. Of the surgeons who experienced inconsistencies in the handling of cement, 77% had storage temperatures that were not constant and 60% said that their theatre temperatures were erratic.

Femoral cementing practices

Of respondents, 312 (55%) indicated that the cement was brought into the theatre during or just before the operation, 22% (123) said that the cement was always stored in the theatre, left in the theatre overnight or brought into the

Figure 5 Timing of cement introduction.

theatre 2 h before the operation. The remainder did not know the routine or had suggested other practices.

Cement was vacuum mixed by 94% of the surgeons either in a cement gun (56%) or in a bowl (38%). Cement was mixed by hand by 5% of the surgeons while 1% of the respondents preferred other methods. Overall, 98% plugged the femoral canal with proprietary restrictors (80%), bone block (17%), cement plugs (2%) or other methods (1%). The canal was prepared with pulsed lavage in 87% and brushes by 46%. Of the surgeons, 95% used a cement gun to deliver the cement while 4% used finger packing; 33% of the respondents vented the canal.

Of the surgeons ($n = 459$), 80% use time elapsed from the start of mixing rather than consistency of the cement as a guide to the timing of cement delivery. In this group, however, 70% were unaware of the time recommended by the manufacturers. The time intervals for delivering cement are shown in Figure 5.

Of the surgeons, 79% pressurised the cement with a finger (33%), with proprietary pressurisers (30%) or both (36%) before stem insertion. The decision to insert the stem was based on time elapsed from mixing by 80% of the surgeons and on consistency by the rest. The timing of stem insertion is shown in Figure 6. Some 88% maintained pressure on the stem till the cement had set. Of the respondents, 62% used implants with stem centralisers (distal only, 60%) and 38% used implants that did not have stem centralisers.

Discussion

Use of cement

The survey identifies a preference for high-viscosity cements and antibiotic-containing cement in primary hip replacement. This is a positive trend, considering reports of reduced revision rates with the use of high viscosity cement for aseptic loosening⁵ and antibiotic-containing cement in combination with systemic antibiotics for septic loosening.⁶

The polymerisation of cement is highly dependent on the ambient room temperature and the starting temperature of the components.¹ Over two-thirds of the surgeons in the survey identified inconsistencies with the setting of the

Figure 6 Timing of stem insertion.

cement. Fluctuations in ambient theatre temperature were implicated as the single most important factor. The dough time, setting time and working times are reduced with increase in theatre temperature.⁷ Farrar *et al.*⁸ noted that it takes roughly 50% less time for a cement to reach a given viscosity when the temperature changes from 19°C to 25°C thus giving the surgeon proportionately less time to complete cementing.

The temperature at which cement is stored affects its starting temperature. A lower temperature increases working time^{9,10} and *vice versa*. More than half of respondents said that cement was not stored at theatre temperature and over a quarter felt that this temperature was not constant. Of surgeons, 6% stored the cement at temperatures below 10°C. The survey also showed that in more than half the cases the cement was brought into the theatre just before or during the operation. The temperature of the cement may, therefore, have differed from theatre temperature. This would influence the rate of polymerisation.

The effect of storage temperature of cement and its setting properties, especially when cement is stored at temperatures different from that recommended by the manufacturers, needs to be investigated further. The time it takes for cement to equilibrate with the theatre temperature needs to be examined to determine optimum storage of cement. Standardising practice to ensure that the temperature fluctuations are minimal in the environment where cement is stored and mixed would help to reduce the problem of inconsistent cement handling during surgery.

Femoral cementing techniques

The goal of 'modern' cementing methods is to optimise the bone-cement interface, enhance fixation and improve survival of the femoral implant. Vacuum mixing systems, cement guns, canal restrictors, pulsed lavage systems, stem centralisers and, above all, sustained pressurisation of cement achieve this aim.

Earlier studies had indicated a lack of consensus among UK surgeons as to the best method of femoral cementing.^{5,4} Only 25% of surgeons used modern cementing¹⁴ and clinical evidence supported the first generation techniques.^{11–13} The results of this study show that more surgeons have taken to modern cementing techniques. This trend is encouraging, with further reports of excellent long-term survival of femoral fixation using this method.¹⁵

Conclusions

Many more surgeons in the UK have adopted the third-generation cementing technique in hip arthroplasty. However, inconsistencies in the time-dependent material

properties of cement remain a cause of concern. Uncontrolled and inconsistent temperature is an important contributing factor. While it may not always be possible to ensure a constant storage or theatre temperature, a better awareness of these variables may contribute to better control and standardisation. This combined with better cementing practices augurs well for improved performance of total hip replacement.

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