COVER SHEET

EARLY PROSTHETIC COMPLICATIONS AFTER UNIPOLAR HEMIARTHROPLASTY

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Key Words

Hip, Hemiarthroplasty, Cement, Fracture

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Abstract

Background

In Australia the most frequently employed hemiarthroplasty prosthesis for the management of displaced intracapsular femoral neck fractures is the Uncemented Austin Moore (UAM). Despite concerns regarding poor functional outcomes and increased early revision rates associated with the UAM prosthesis, apprehension regarding the systemic side effects of polymethylmethacrylate cement implantation in the elderly patient continues to influence prosthesis selection. This study examines the incidence of early prosthesis related complications after UAM and Cemented Thompson (CT) hemiarthroplasty procedures for the management of femoral neck fractures.

Methods

A multicentre retrospective review of charts and radiographs was conducted in order to determine early prosthetic complications associated with the CT and UAM prostheses over a 6 year period in five Queensland public hospitals.

Results

Intraoperative periprosthetic fractures were sustained in 11.8% of UAM and 1.8% of CT implantations ($p<0.0001$). Intraoperative periprosthetic fractures were associated with an increased requirement for reoperation within 1 month of the index procedure ($p=0.05$). No statistical difference in the incidence of intraoperative periprosthetic fractures could be observed between the hospitals participating, regardless of the proportional use of each prosthesis. Early dislocation rates were similar for the UAM and CT prostheses. The intraoperative mortality rate attributable to the use of polymethylmethacrylate cement during hip hemiarthroplasty was 1/ 738 (0.14%).

Conclusions

The results of this study support the use of the CT prosthesis for the management of femoral neck fractures to reduce the high incidence of intraoperative periprosthetic fractures and associated requirements for early reoperation experienced with the UAM.

Introduction

In Australia the most frequently employed hemiarthroplasty prosthesis for the management of displaced intracapsular femoral neck fractures is the Uncemented Austin Moore (UAM).[1] The Australian Orthopaedic Association National Joint Registry 2004 has now reported on 7679 unipolar hip prostheses over a three year period. Although at this stage only relatively early results, the UAM has demonstrated higher revision rates compared to the Cemented Thompson (CT), with over 6% of implantations requiring revision within 2.5 years (HR 2.89; 95% CI 1.8 – 4.6; $p<0.0001$).[1] The registry concludes on the basis of these observations that continued use of the UAM is becoming increasingly difficult to justify.[1] Foster et. al. (2005) in a review of 244 patients undergoing UAM or CT for femoral neck fractures found a 7% periprosthetic fracture rate over a 2 year period in patients managed with the UAM prosthsis.[2] There were no periprosthetic fractures observed in 174 patients managed with the CT over the same time period ($p=0.002$) and the periprosthetic fracture rate was found to be independent of age or gender. Jadhav et. al. (1996) reviewed the 12 – 48 month results of 40 patients managed with the UAM prosthesis and demonstrated 70% had pain of non infective origin, with calcar resorption detected in 85% of implantations and radiological evidence of stem migration in the majority of cases.[3]

Obtaining satisfactory clinical results after implantation of the UAM prosthesis is reliant on accurate and reproducible surgical practice as multiple factors in the operative technique have been demonstrated to result in early failure of the prosthesis. Sharif & Parker (2002) in a review of 12 month outcomes after UAM implantation in 243 patients found 25.1 % of patients had residual hip pain and 7% required revision within one year for aseptic loosening.[4] The incidence of hip pain and revision surgery at one year was higher in patients with a prosthesis not seated flush on the femoral calcar, an inappropriate selection of prosthetic head size or short neck resections detected on immediate postoperative anterior-posterior radiographs.[4] Kwok & Cruess (1982) in a review of 599 Austin Moore and Thompson hemiarthroplasty implantations concluded that dislocation of the UAM prosthesis was associated with inappropriate neck resection length and improper selection of prosthetic head size.[5] Yau & Chiu (2004) in a series of 44 patients managed with the Austin Moore prosthesis for acute displaced fractures of the

femoral neck at 2 – 7 year follow up found proximal metaphyseal fill of less than 70% was associated with subsidence and postoperative pain.[6]

Despite concerns regarding the poor functional outcome and increased revision rates associated with the UAM prosthesis, apprehension about the systemic effects of PMMA acrylic cement implantation in the elderly patient continues to influence prosthesis selection. Cement insertion has been demonstrated to adversely effect pulmonary and cardiovascular function during the conduct of surgery and the immediate postoperative period, which may be poorly tolerated in the elderly with preexisting comorbidity.[7,8] Parvizi et. al. (1999) in a review of 38488 hip Arthroplasty procedures reported 23 intraoperative deaths due to irreversible cardio-respiratory disturbances initiated during cementing. 12 of the 23 deaths were in patients undergoing cemented hemiarthroplasty. No intraoperative deaths were recorded in any of the 15411 uncemented hip replacements during the 28 year period. Elderly patients with preexisting cardiovascular conditions undergoing arthroplasty for the management of hip fractures were identified as patients at risk of intraoperative death associated with the use of cement.[9] Similarly Patterson et. al (1991) in a review of 7 intraoperative cardiac arrests occurring during hip arthroplasty implicated advanced age, osteoporotic bone and larger volumes of cement as risk factors during the cementing process.[10]

The objective of this study is to examine the early prosthesis related complication rates after UAM and CT hemiarthroplasty implantation for the management of femoral neck fractures.

Methods

A multicentre retrospective review of charts and radiographs was conducted in order to determine early prosthetic complications associated with the CT and UAM prostheses. Five public hospitals in Queensland, Australia participated in the study. Patients were identified by ICD-10 procedure diagnosis code. Inclusion criteria were the use of either the UAM or CT monoblock prostheses for management of femoral neck fracture or failed internal fixation within the 6 year period from 01 January 1998 to 30 November 2003. Patients who were managed with a hemiarthroplasty other than the UAM or CT were excluded.

Endpoints were selected to reflect outcomes most likely to be influenced by prosthesis choice. Due to the retrospective methodology, a limited number of unambiguous end points were selected in order to allow reliable data collection. As capturing the information retrospectively was considered to be less accurate beyond the immediate perioperative period, 1 month from the initial procedure was selected as the time frame for discontinuing data collection.

This study considered four end points:

1. Intraoperative periprosthetic fracture;
2. Intraoperative death;
3. Reoperation on the same hip (any reason) within 1 month of procedure; and
4. Dislocation within 1 month of initial procedure.

Intraoperative fractures were defined using Vancouver classification for periprosthetic fractures.[11] Statistical analyses were conducted using chi-squared or Fischer exact tests depending on the data set.

Results

1360 patients underwent hemiarthroplasty of the hip joint during the time period (Figure 1). Hospital records were missing or incomplete in 65 (4.8%) patients, and these were excluded from analysis. 177 patients were managed with a hemiarthroplasty other than the UAM or CT prosthesis and were therefore excluded from the study. Bipolar hemiarthroplasty was conducted in 145 patients, cemented Austin Moore in 2 patients and uncemented Thompson in 30 patients. Hospital 3 used a bipolar device in 108 of 460 (23.5%) of hip hemiarthroplasty procedures conducted at that institution, however all other hospitals used a bipolar device in less than 10% of cases.

1118 implantations were included for data analysis after exclusions. The CT prosthesis was used in 738 (66%) of patients, and UAM in 380 (34%). Significant regional variation in prosthesis selection used was observed, and this is presented in Figure 2. 26 patients had bilateral sequential procedures, 1 patient required simultaneous procedures for bilateral acute displaced fractures of the femoral neck. 1107 implantations were undertaken for acute intracapsular fractures of the femoral neck, 11 procedures were

undertaken for failed internal fixation. 356 (93.7%) of UAM and 708 (95.9%) of CT implantations were conducted by Registrars (p=0.096; $\chi 2$ test).

Intraoperative periprosthetic fractures were sustained in 45/ 380 (11.8%) UAM and 13/ 738 (1.8%) CT implantations (Figure 3; p<0.0001 $\chi 2$ analysis). Of the procedures conducted by a Consultant Orthopaedic surgeon, 5/ 24 (20.8%) of UAM and 0/30 (0%) CT implantations resulted in periprosthetic fractures during implantation (p=0.01; Fisher Exact). No statistical difference in the incidence of intraoperative periprosthetic fracture was observed between Registrars and Consultants for either the CT (p= 0.59; two-tailed Fisher Exact) or UAM prostheses (p=0.10; $\chi 2$ analysis), although the total number of

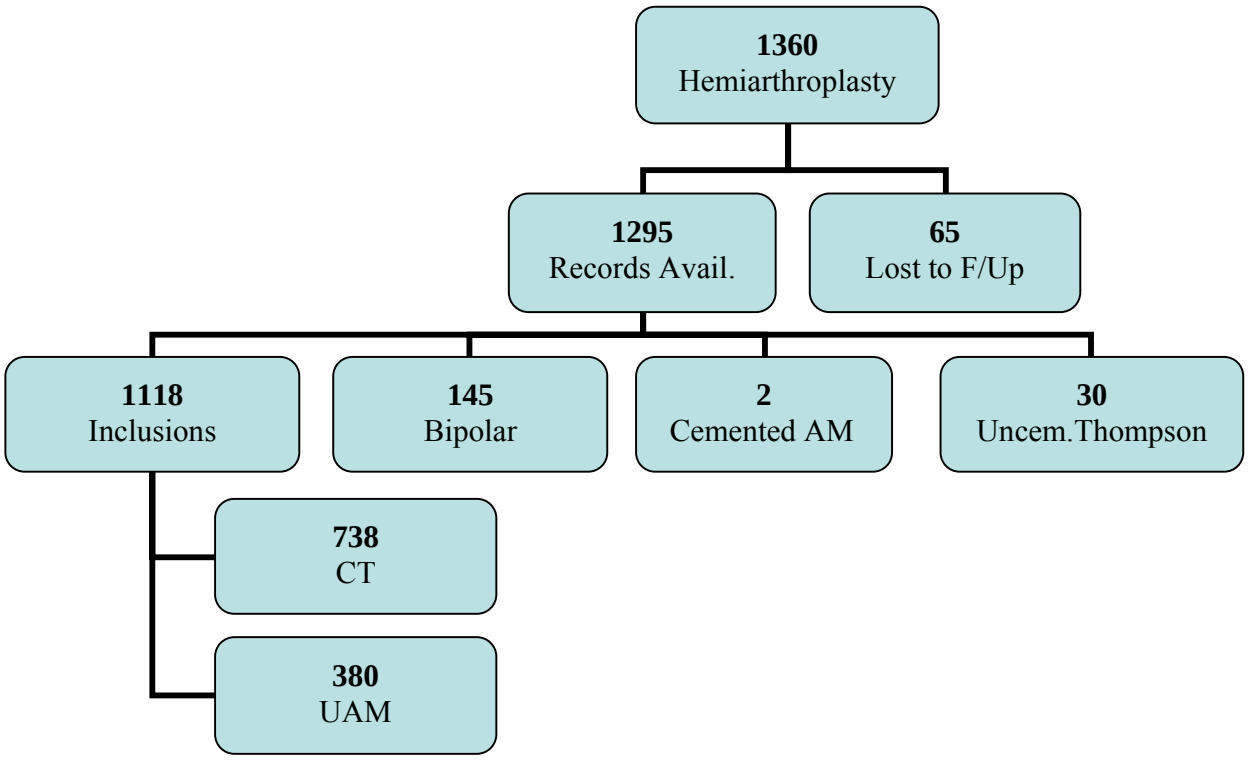

Figure 1: Patients excluded from data analysis and frequency of prosthetic usage.

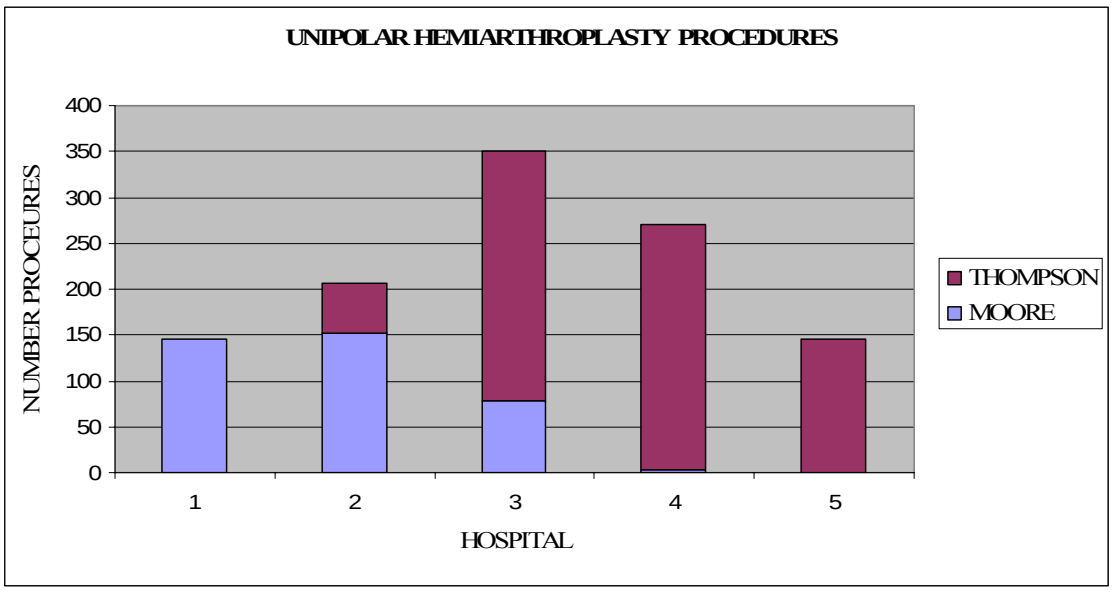

Figure 2: 1118 Unipolar hemiarthroplasty procedures conducted at participating hospitals over a 6 year period. From left to right increasing proportional use of the CT prosthesis is observed.

procedures conducted by Consultants was low. Comparing the fracture incidence between hospitals demonstrated a correlation between intraoperative periprosthetic fracture incidence and increased proportional use of the UAM prosthesis (Pearson correlation 0.972; $p=0.006$). Hospital 1 (exclusive use of the UAM) reported intraoperative periprosthetic fractures in 22/ 146 (15.1%) of hemiarthroplasty procedures, which was significantly higher than that observed in Hospital 5 (exclusive use of CT) which sustained fractures in 2/ 146 patients (1.3%) ($p<0.0001$; Fisher Exact Test). Institutions which selectively used the UAM for frail and low demand patients (Hospitals 3 and 4) did not demonstrate a higher incidence of fractures when using this prosthesis compared to institutions using this prosthesis routinely (Hospitals 1 and 2) ($p=0.29$; $\chi 2$ analysis) (Figure 4).

46/58 (79.3%) patients sustaining an intraoperative periprosthetic fracture required internal fixation, and in 42 cases this was performed as part of the index procedure. Reoperation within 1 month of the index procedure was required in 5/58 (8.6%) of patients sustaining an intraoperative periprosthetic fracture and 43/ 1062 (4%)

of patients not sustaining an intraoperative fracture during the index procedure (p=0.05; Fisher Exact). Of the five patients requiring reoperation after sustaining an intraoperative periprosthetic fracture, four required their additional procedure specifically for fracture management and one for infection. Of the 43 patients not sustaining an intraoperative periprosthetic fracture during the index procedure and requiring reoperation within 1 month, 16 patients required open or closed reduction of dislocations, 14 patients evacuation of haematoma, 12 patients washout and debridement of infection and 1 patient required removal of excess PMMA cement. Dislocation was not associated with intraoperative periprosthetic fracture (p=0.2; Fishers Exact).

Intraoperative periprosthetic fractures sustained during implantation of the CT prosthesis were in all 13 patients type A according to the Vancouver Classification. 10/ 13 fractures were managed with circlage wire and 3/13 were assessed as stable not requiring internal fixation. 39/ 45 (86.7%) of intraoperative periprosthetic fractures

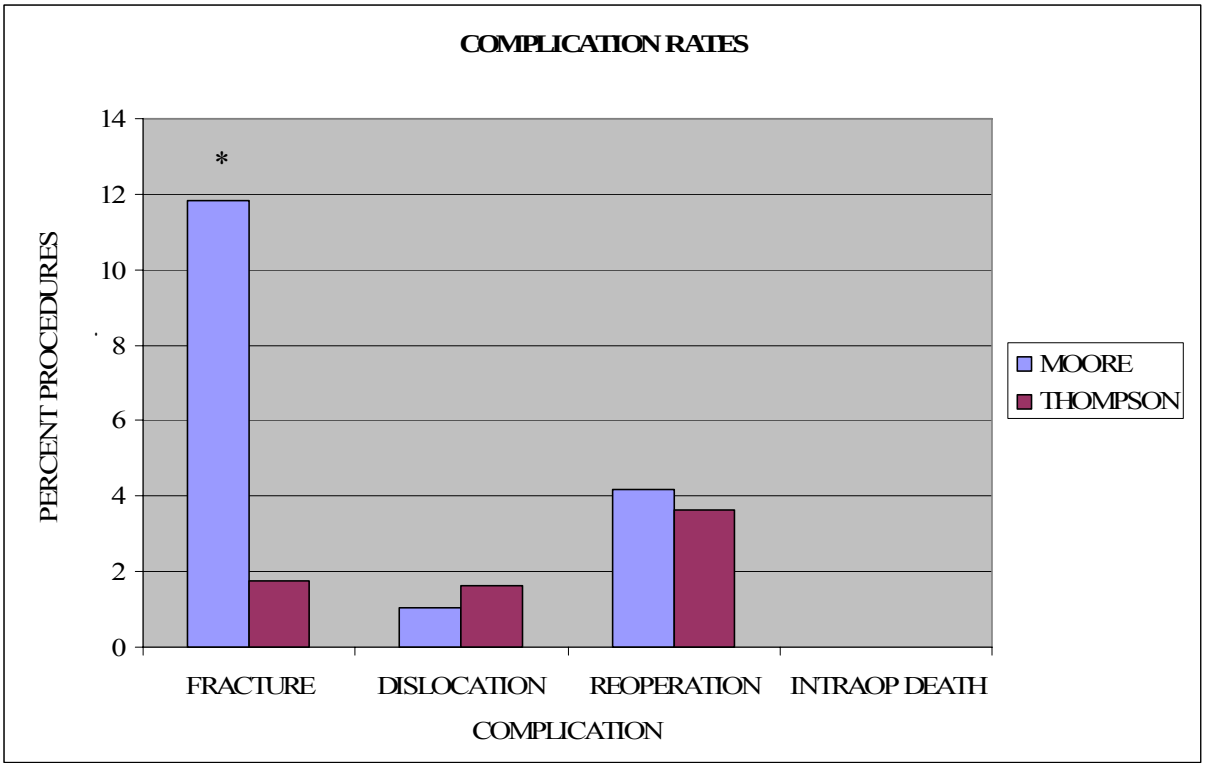

Figure 3: Complication rates for Uncemented Austin Moore and Cemented Thompson prostheses. * p<0.0001

sustained during insertion of the UAM prosthesis were Vancouver Classification A, and 6 (13.3%) were Type B. 32/ 39 Type A fractures sustained with the UAM prosthesis required internal fixation with circlage wire, and 2 prostheses were in addition cemented in order to improve prosthetic stability. All Type B periprosthetic fractures sustained during implantation of the UAM prosthesis required internal fixation, 5 using circlage wire and one requiring plate fixation.

No statistical difference in the incidence of prosthetic dislocation or reoperation within 1 month of the index procedure could be detected between the CT and UAM implants (Figure 3). Only 1 intraoperative death was recorded. This patient was being managed for an acute femoral neck fracture with a Thompson prosthesis and cement was considered a contributing factor to the arrest. There was no statistical difference in the incidence of intraoperative death between the CT and UAM prostheses ($p>0.95$; Fisher Exact).

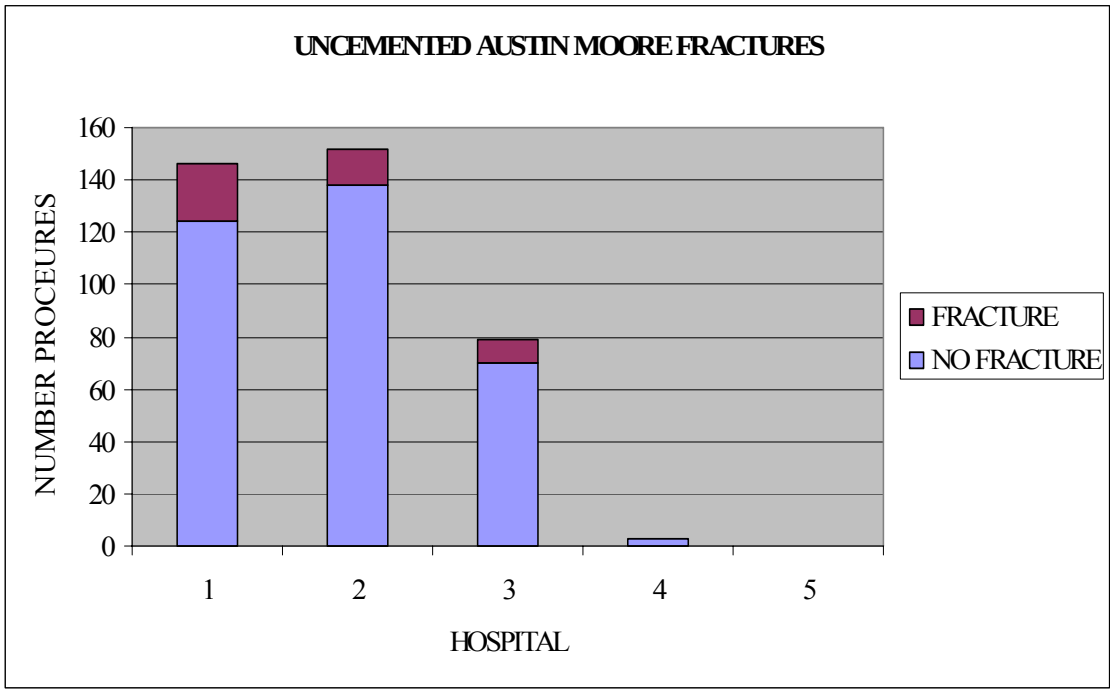

Figure 4: Intraoperative periprosthetic fractures sustained during implantation of the uncemented Austin Moore prosthesis. No statistical difference in fracture incidence is observed between hospitals using this prosthesis.

Discussion

This series demonstrates a significantly greater incidence of intraoperative periprosthetic fractures when using the UAM compared to the CT prosthesis. The majority of patients sustaining intraoperative periprosthetic fracture in this series required additional internal fixation during their index procedure. Intraoperative periprosthetic fractures were also associated with a statistically higher reoperation rate. Patient selection bias is unlikely to explain the higher incidence of intraoperative periprosthetic fracture with the UAM prosthesis, as the fracture rate is independent of the proportional use of either prosthesis at the hospitals involved. Institutions which exclusively or predominantly used the UAM (Hospitals 1 and 2) had an equivalent fracture incidence to those institutions which selectively reserved the UAM for frail patients with shorter life expectancy (Hospitals 3 and 4). In addition, Hospital 1 (exclusive use of the UAM) demonstrated a significantly higher complication rate compared to Hospital 5 (exclusive use of CT), with an 8.6 times greater incidence of intraoperative periprosthetic fractures. Within the hospitals participating in this study, displaced subcapital femoral neck fractures were consistently treated with either the UAM or CT prostheses. No alternative unipolar prosthesis was used for any patient in this series and bipolar prostheses were used infrequently. Internal fixation or total hip arthroplasty are procedures infrequently performed for displaced intracapsular femoral fractures at the hospitals participating in this study.[12] Preferential selection of relatively healthy patients to receive alternative treatments does therefore not explain the high complication rate observed with the UAM prosthesis. The high intraoperative periprosthetic fracture incidence demonstrated in this series is independent of surgeon experience as Consultant Surgeons and Registrars sustained fractures using the UAM prosthesis with equal frequency.

The use of acrylic cement in the elderly population remains a concern to many orthopaedic surgeons. Within this series only one intraoperative death in 738 CT implantations was recorded. This is consistent with the findings of Pavarzi et. al. who demonstrated the incidence of intraoperative death contributed by the use of acrylic bone cement during hip hemiarthroplasty to be less than 0.2% [9]. The risk of intraoperative complications related to the use of cement may be reduced by venting the femur,

avoiding excessive pressurization during insertion and adequate preoperative hydration.[9,10,13] Offset against the quantitatively small risk associated with the use of acrylic bone cement are the significant advantages demonstrated for its use in hemiarthroplasty of the hip joint. Khan et. al. (2002) reviewed the results of 244 patients managed with the Austin Moore prosthesis with and without the use of cement. At 32 – 36 month follow up patients who were managed without cement had greater pain ($p=0.003$), and reduced functional capacity vis. walking ability ($p=0.002$), use of walking aids ($p=0.003$) and activities of daily living ($p=0.009$). The use of cemented hemiarthroplasty in the elderly was supported by these findings.[14] Similarly the Australian Joint Registry 2004 Annual Report recommend the critical factor influencing results after hemiarthroplasty of the hip joint is the use of cement. Registry data suggest the Thompson prostheses inserted without cement has a similar failure rate to the uncemented Austin Moore, but if an Austin Moore prosthesis is cemented then the incidence of early revision is similar to that seen with the Cemented Thompson.[1] Parker and Gurusamy (2004) in a meta analysis of fifteen trials involving 1670 patients concluded cemented prostheses were associated with a lower risk of failure to regain mobility (HR 0.60; 95% confidence interval (CI) 0.44 to 0.82) and a lower incidence of postoperative pain at one year (HR 0.51; 95% CI 0.31 to 0.81).[15] It would appear therefore that the choice of which hemiarthroplasty prosthesis to use is less important than the decision to use cement.

Results of this study support the use of the Cemented Thompson prosthesis for the management of femoral neck fractures to reduce the high incidence of intraoperative periprosthetic fracture experienced with the Uncemented Austin Moore. Intraoperative fracture sustained during hemiarthroplasty implantation frequently requires internal fixation and is associated with an increased requirement for early reoperation. Routine use of the Cemented Thompson prosthesis for management of femoral neck fractures in the elderly has not been demonstrated to be associated with an increased incidence of intraoperative death compared to the Uncemented Austin Moore prosthesis.

Acknowledgements

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