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Cemented Thompson versus cemented bipolar prostheses for femoral neck fractures

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ABSTRACT

Purpose. To compare early functional outcomes, complications, and mortality in elderly patients treated with the less costly, cemented Thompson prosthesis or the cemented bipolar prosthesis in order to identify factors affecting outcomes.

Methods. Records of 303 patients with femoral neck fractures treated with the cemented Thompson monoblock prosthesis (n=206) or the cemented bipolar prosthesis (n=97) were reviewed. The choice of prosthesis was solely determined by surgeon's preference. Data relating to patient demographics, clinical and residential status, mobility, mental function, mortality, and complications during hospitalisation and rehabilitation were collected.

Results. After adjusting for confounding variables, independent postoperative indoor mobility was associated with preoperative indoor mobility ($p=0.002$) and mental function ($p=0.001$), whereas postoperative outdoor mobility was associated with preoperative outdoor mobility ($p=0.003$), daily living activity ($p=0.02$), and mental function ($p=0.02$). Mortality within 6 months was only associated with poor mental function ($p=0.009$). At 6-month follow-up, there was no significant difference between the 2 types of prosthesis in terms of functional outcomes, mortality and complication rates.

Conclusion. In elderly patients with limited mobility, treatment with the bipolar prosthesis was not associated with better short-term outcomes than those receiving the Thompson prosthesis.

Key words: *arthroplasty; femoral neck fractures; hip prosthesis*

INTRODUCTION

In Australia, the number of people aged >85 years is projected to double over the next 20 years and triple over 50 years to reach about 2.3 million.[1] Femoral neck fractures in the elderly are therefore projected to pose an enormous burden to health care systems. Implants to treat these fractures vary in design and

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cost. Depending on the patient's general condition, presence of osteoarthritis, hospital guidelines, and surgeon preferences, treatment options include cemented or uncemented unipolar monoblock hemiarthroplasty (such as the Thompson, Moore or Exeter trauma stem), cemented mono- or bipolar modular prostheses, and total hip replacements (THR). The cemented Thompson prosthesis is often selected for older, inactive patients owing to associated good outcomes and low costs.[2,3] Its popularity varies owing to the lack of consensus on treatment guidelines and the optimal implant for different groups of patients.[4] According to the Australian National Joint Replacement Registry, usage of the Thompson prosthesis for intracapsular femoral neck fractures varies from 10% in Western Australia to 50% in Victoria, with falling trends in all states.[5]

We compared early functional outcomes, complications, and mortality in elderly patients treated with the less costly, cemented Thompson prosthesis or the cemented bipolar prosthesis in order to identify factors affecting outcomes.

MATERIALS AND METHODS

Records of 303 patients with femoral neck fractures treated with the cemented Thompson monoblock prosthesis (n=206) or the cemented bipolar prosthesis (n=97) between 1 January 2000 and 31 December 2003 were reviewed. The choice of prosthesis was solely determined by surgeon's preference. Patients with bilateral fractures, very poor mental function, metastatic malignant disease, or severe Parkinson's disease were excluded.

Data relating to patient demographics, clinical and residential status, mobility, mental function, mortality, and complications during hospitalisation and rehabilitation were collected. Follow-up was for 6 months; loss to follow-up was <10%.

The Thompson monoblock (Smith & Nephew, Tuttlingen, Germany) and a modular stem (Exeter V40, Benoist Gerard, Saint Clair Cedex, France) with a bipolar head (Stryker UHR, Meyziew Cedex, France) were used with Simplex cement (Stryker, Limerick, Ireland). All arthroplasties were carried out via a transgluteal lateral approach.

The primary outcome variable was function, as determined by indoor and outdoor mobility and residence after discharge. Mobility was classified into 10 categories (independent with no aids, independent plus stick, independent plus quad stick/crutches, independent with frame, independent with forearm frame, assistance of one or more persons, assistance plus aid, wheelchair dependent, bedfast, and not applicable). The first 5 categories were classified as mobile and the remaining categories (apart from the last) as immobile. The residence after discharge represented activities of daily living and was classified into 9 categories (home alone, home with others [independent], home with others [dependent], rehabilitation hospital, nursing home, hostel, others, deceased, unknown). The first 2 categories were defined as independent, and the remaining categories (apart from the last 3) as dependent.

Secondary outcome variables were mortality (during hospital stay and after discharge), prosthetic complications (dislocation, loosening, acetabular erosion, periprosthetic fracture, other, and none), and infection (superficial and deep).

Categorical and continuous outcome variables of the 2 types of prosthesis were compared using the Pearson Chi squared test and *t*-test, respectively. The independent effect of the types of prosthesis on functional outcome variables was assessed using multiple logistic regression analysis. In the first approach (model A), all possible predictors of functional outcomes were entered. These included type of prosthesis, patient age, cardiac or cerebrovascular disease, preoperative mobility, activities of daily living, and mental function. In the second approach (model B), a propensity score was added to control for possible selection bias. The propensity score represented the probability of choosing the Thompson prosthesis instead of a bipolar prosthesis and was generated by logistic regression analysis using patient age, type of fracture, comorbidity, preoperative mobility, and activity of daily living as predictors for influencing the choice of prosthesis. A p value of <0.05 was considered statistically significant. No predictor was removed in the multivariate analyses.

RESULTS

The cemented Thompson prosthesis was used more often than the cemented bipolar prosthesis (206 vs. 97), especially in older patients, those with comorbidities, dependent preoperative mobility, or poor mental function or activities of daily living (Table 1).

After 6 months of follow-up, patients having bipolar prostheses were associated with a lower incidence of urinary tract infection, shorter length of hospital stay, better discharge outcomes, and better indoor and outdoor mobility (Table 1). There was no significant difference between the 2 types of

Table 1
Patient characteristics and outcome

Variable	Thompson prosthesis (n=206)	Bipolar prosthesis (n=97)	p Value
Age (years)	85±7	78±8	0.001
>80	158 (77)	41 (42)	0.001
>85	108 (52)	17 (18)	0.001
Female	164 (80)	76 (79)	0.880
Type of fracture			0.274
Garden I	1 (0)	0 (0)	
Garden II	7 (3)	0 (0)	
Garden III	34 (17)	16 (16)	
Garden IV	164 (80)	81 (84)	
Comorbidity			
Severe cardiac disease	106 (52)	29 (30)	0.001
Cerebrovascular disease	14 (7)	4 (4)	0.044
History of malignancy	10 (5)	1 (1)	0.184
Urinary incontinence	42 (21)	14 (14)	0.267
Mental function			0.006
Good	108 (52)	68 (70)	
Poor	98 (48)	29 (30)	
Preoperative mobility			
Independently indoor	138 (69)	88 (91)	0.001
Independently outdoor	124 (65)	86 (89)	0.001
Activity of daily living			0.001
Independent	124 (61)	80 (83)	
Dependent	82 (40)	17 (18)	
Revision of prosthesis	3 (2)	1 (1)	
Prosthesis complication	13 (6)	5 (5)	0.799
Dislocation	5 (2)	2 (2)	
Loosening	1 (1)	0 (0)	
Acetabular erosion	4 (2)	2 (2)	
Periprosthetic fracture	3 (2)	1 (1)	
Complication			
Urinary tract infection	68 (33)	20 (21)	0.030
Deep wound infection	6 (3)	4 (4)	0.731
Pneumonia	14 (7)	4 (4)	0.442
Pulmonary embolism	1 (1)	1 (1)	0.541
Length of hospital stay (days)	25±20	18±13	0.001
Residence after discharge			
Home independent	72 (35)	62 (64)	
Home dependent	25 (12)	10 (10)	
Rehabilitation hospital	37 (18)	15 (16)	
Nursing home	28 (14)	2 (2)	
Hostel	37 (18)	8 (8)	
Mortality	7 (3)	0 (0)	
Postoperative mobility			
Independently indoor	82 (48)	88 (77)	0.001
Independently outdoor	67 (42)	65 (71)	0.001
Mortality at month 6	27 (13)	6 (6)	0.078

* Data are presented as mean±SD or no. (%) of patients

prosthesis in terms of prosthetic complications, deep wound infection, pneumonia, pulmonary embolism, and mortality (Table 1).

More mobile and younger patients with bipolar prostheses had significantly better outcomes. After adjusting for confounding factors and selection bias, predictors of postoperative indoor mobility were preoperative indoor mobility (p=0.002) and mental function (p=0.001), whereas predictors of postoperative outdoor mobility were preoperative outdoor mobility (p=0.003), activities of daily living (p=0.02), and mental function (p=0.02). Mortality was significantly influenced by mental function.

Six patients developed clinically significant acetabular erosion. All were younger than 80 years and independently mobile indoors. Three Thompson prostheses were revised for deep infection, dislocation, and periprosthetic fracture, whereas one

Table 2
Variables associated with independent postoperative indoor and outdoor mobility

Variable	Independent postoperative indoor mobility*		Independent postoperative outdoor mobility†	
	Odds ratio (95% CI)	p Value	Odds ratio (95% CI)	p Value
Model A				
Thompson (vs bipolar) prosthesis	0.53 (0.25–1.13)	0.099	0.77 (0.35–1.68)	0.504
Age, per year increment	0.96 (0.92–1.01)	0.080	0.92 (0.87–0.96)	0.001
Cardiac disease	0.71 (0.36–1.31)	0.306	0.68 (0.34–1.37)	0.276
Cerebrovascular disease	0.40 (0.11–1.49)	0.169	0.21 (0.03–1.32)	0.096
Independent preoperative indoor mobility	9.04 (3.46–23.58)	0.001	-	-
Independent preoperative outdoor mobility	-	-	20.81 (5.96–72.74)	0.001
Independent daily living activity	3.25 (1.53–6.94)	0.002	4.23 (1.69–10.59)	0.002
Good mental function	2.77 (1.42–5.34)	0.004	2.40 (1.15–5.01)	0.020
Model B				
Thompson (vs bipolar) prosthesis	0.59 (0.27–1.27)	0.175	0.78 (0.35–1.71)	0.531
Age, per year increment	1.07 (0.95–1.21)	0.242	0.96 (0.78–1.18)	0.684
Cardiac disease	1.22 (0.54–2.72)	0.636	0.80 (0.28–2.30)	0.697
Cerebrovascular disease	0.95 (0.19–4.66)	0.946	0.26 (0.03–2.11)	0.208
Independent preoperative indoor mobility	5.91 (1.92–18.14)	0.002	-	-
Independent preoperative outdoor mobility	-	-	15.72 (2.61–94.81)	0.003
Independent daily living activity	2.27 (0.96–5.41)	0.063	3.69 (1.21–11.24)	0.022
Good mental function	3.06 (1.54–6.08)	0.001	2.38 (1.14–4.98)	0.021
Propensity score (per 10% increment in the probability of choosing a Thompson prosthesis)	0.61 (0.37–0.99)	0.044	0.19 (0.52–2.74)	0.676

* Respectively in models A and B, Hosmer-Lemeshow chi-square is 8.1 (p=0.425) and 4.5 (p=0.812), whereas Nagelkerke R^2 is 0.473 and 0.485

† Respectively in models A and B, Hosmer-Lemeshow chi-square is 5.8 (p=0.666) and 5.3 (p=0.727), whereas Nagelkerke R^2 is 0.537 and 0.538

bipolar prosthesis was revised for dislocation.

In model A, independent postoperative indoor mobility was significantly associated with independent preoperative indoor mobility (odds ratio [OR] 9.04; 95% confidence interval [CI], 3.46–23.58), good mental function (OR, 2.77; 95% CI, 1.42–5.34), and independent activities of daily living (OR, 3.25; 95% CI, 1.53–6.94) (Table 2). After adjustment for possible selection bias (model B), the predictors were good mental function and independent preoperative indoor mobility (Table 2). The type of prosthesis was not a predictor for postoperative indoor mobility. However, the propensity score was a significant factor in determining postoperative indoor mobility, indicating the possibility of residual confounding by the differences in baseline patient characteristics.

In model A, independent postoperative outdoor mobility was associated with patient age (OR, 0.92; 95% CI, 0.87–0.96), preoperative outdoor mobility (OR, 20.81; 95% CI, 5.96–72.74), activities of daily living (OR, 4.23; 95% CI, 1.69–10.59), and mental function (OR, 2.40; 95% CI, 1.15–5.01). After inclusion of a propensity score (model B), preoperative outdoor mobility, activities of daily living, and mental function remained predictors (Table 2). Survival at month 6 was only associated with good mental function (OR, 0.29; 95% CI, 0.11–0.74, Table 3). Pre-existing cardiac disease (0.095) and a history of malignancy (p=0.093) had a tendency to association with mortality at month 6.

DISCUSSION

Consistent with findings in our study, no significant difference between the cemented Thompson monoblock and the cemented bipolar prostheses with regard to postoperative function (ambulation, activities of daily living, Harris Hip Score, pain, and satisfaction) has been reported.[3,6]

There is a trend towards decreased popularity of monoblock and modular bipolar implants in favour of modular unipolar implants in Australia and the United States. The reduction in use of cementless monoblock implants was ascribed to poorer outcomes (in terms of loosening, pain, periprosthetic fractures) and higher revision rates.[5,7–10] The more expensive bipolar implants have little benefit over unipolar implants.[6,11–13]

Table 3
Variables associated with mortality 6 months after hemiarthroplasty*

Variable	Odds ratio (95% CI)	p Value
Thompson (vs bipolar) prosthesis	1.18 (0.39–3.59)	0.775
Age, per year increment	1.02 (0.96–1.09)	0.565
Cardiac disease	2.24 (0.87–5.76)	0.095
Male gender	1.06 (0.44–2.55)	0.895
History of malignancy	4.05 (0.79–20.70)	0.093
Cerebrovascular disease	1.17 (0.23–5.97)	0.857
Independent preoperative outdoor mobility	2.44 (0.22–27.14)	0.467
Independent preoperative indoor mobility	0.25 (0.023–2.70)	0.253
Independent daily living activity	0.79 (0.29–2.15)	0.645
Good mental function	0.29 (0.11–0.74)	0.009

* Hosmer-Lemeshow chi-square=7.1 (p=0.523) and Nagelkerke R^2=0.158

Usage of the Thompson prosthesis is also in decline, as conversion and revision of the Thompson prosthesis for dislocation, infection, acetabular erosion, and periprosthetic fracture is difficult. The difficulties during revision to a THR were attributed to the lower cut at the level of the lesser trochanter and difficulty removing the implant due to its bow and surface finish, which leads to a high frequency of major perioperative complications.[14,15] The new monoblock Exeter stem might be advantageous in revision situations, but to date the relevant results have not yet been published.

Another disadvantage of the Thompson implants is related to acetabular erosion, which is closely associated with patient age and activity levels,[14,16] as well as the duration of the prosthesis *in situ*. Predictors of inactivity are age over 80 years and age over 70 years if residing in a nursing home. In our study, 4 patients with the Thompson prosthesis and 2 with the bipolar prosthesis developed acetabular erosion related to patient age and activity levels. None of these patients underwent revision surgery within 6 months. There is little evidence to suggest that bipolar and unipolar implants are less likely to induce erosions, compared to Thompson prostheses.

Revision of the Thompson prosthesis to a THR is rarely indicated in immobile and frail patients. Careful selection of the type of hemiarthroplasty to match the patient is of great importance.[15]

Rates of dislocation in hemiarthroplasty range 2 to 12%[17–21]; most occur within the first 6 months of surgery.[21,22] For the Thompson hemiarthroplasty, dislocation rates range from 0 to 7%.[10,21–23] Early dislocation is associated with high mortality (30–75%).[17,21]

Regarding limitations, this study was observational and hence prone to selection bias and confounding by indication. The sample size may have been too small to demonstrate small differences in outcomes between the prostheses. The low incidence of prosthetic complications (n=18, 6%) meant that potential differences related to the prostheses were not revealed. The follow-up period of 6 months appears sufficient for assessing dislocation,[21,23] but may not be sufficient to assess loosening and acetabular erosion. Larger, randomised controlled trials with longer follow-up are needed.

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