Original Article

Unipolar versus Bipolar Hemiarthroplasty for Displaced Femoral Neck Fractures in the Elderly: Is There a Difference?

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Abstract

Introduction: Hip hemiarthoplasties are commonly performed for displaced femoral neck fractures. Considerable differences of opinion exists regarding the choice between unipolar and bipolar designs. The main theoretical advantage of a bipolar over a unipolar prosthesis is the reduction of acetabular erosion due to movement taking place within the implant rather than at the acetabular implant interface. It is thus hypothesised that bipolar prostheses lead to better long-term functional outcomes with less complications. In this study, we aimed to compare unipolar (Moore's) and bipolar hemiarthroplasty looking specifically for differences in 1) pain and functional hip scores; 2) rates of acetabular erosion, component migration and revision surgery; and 3) rates of postoperative morbidity. Materials and Methods: Inclusion criteria were 1) age more than or equal to 65 years; 2) displaced femoral neck fracture of non-pathologic origin; 3) normal cognitive function; 4) ambulatory with or without assistive devices prior to the fracture; and 5) treated with a primary prosthetic replacement. Of the 193 patients that were available for review, 118 were in the Moore's group and 75 in the bipolar group. Postoperatively, patients were assessed with regards to pain, satisfaction, Modified Harris hip score and Oxford hip score. Standard anteroposterior pelvis and lateral hip radiographs were obtained at regular intervals. These were analysed specifically with regards to acetabular erosion and component migration. Results: There was no significant difference between a Moore's and a bipolar prosthesis regarding hip pain, functional hip scores, rates of acetabular erosion, component migration, revision surgery and complications rates. Conclusion: Use of the more expensive bipolar prosthesis in elderly and premorbidly ambulant patient is not justified.

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Introduction

Hip hemiarthoplasties are commonly performed for displaced femoral neck fractures. The advantages of hemiarthroplasty over internal fixation include earlier mobility, less reoperations and better functional outcome at 1 year.[1,2]

Considerable differences of opinion exists regarding the choice between unipolar and bipolar designs. The main theoretical advantage of a bipolar over a unipolar prosthesis is the reduction of acetabular erosion due to movement taking place within the implant rather than at the acetabular implant interface. It is thus hypothesised that bipolar prostheses lead to better long-term functional outcomes with less complications. However, evidence from the literature so far has not been supportive of this theory.[3-7]

All studies so far have found that bipolar implants have a significantly higher cost compared to unipolar implants.[5,8] In our price-sensitive population, we wonder whether the higher costs associated with the use of bipolar implants are justified. The purpose of this study is to compare unipolar (Moore's) and bipolar hemiarthroplasty with the following aims: 1) Are there any differences in terms of pain and functional hip scores?; 2) What are the rates of acetabular erosion, component migration and revision surgery?; and 3) Are the rates of postoperative morbidity similar?

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Materials and Methods

All patients who underwent hemiarthroplasty for displaced neck of femur fractures between 1 January 2004 and 31 December 2007 were analysed from a log of all operative procedures. Inclusion criteria were 1) age more than or equal to 65 years; 2) displaced femoral neck fracture of non-pathologic origin; 3) normal cognitive function; 4) ambulatory with or without assistive devices prior to the fracture; and 5) treated with a primary prosthetic replacement. Patients with a pre-existing hip abnormality requiring total hip replacement or a pathological fracture secondary to malignant disease were excluded.

Patient characteristics examined included age, gender, prefracture ambulatory status, and number of associated comorbidities. Prefracture ambulatory status was classified into the following catagories: 1) independent community ambulatory; 2) community ambulant with assistive devices; and 3) home ambulant. General health status was defined by the number of pre-existing significant comorbid conditions, which included diabetes mellitus, congestive heart failure, cardiac arrhythmias, ischaemic heart disease, previous cerebrovascular accident, renal disease, Parkinson's disease, hypertension, chronic obstructive pulmonary disease, and the need for ongoing anticoagulation. These comorbidities were chosen as the most important ones based on those reported in the literature.[9,10]

Between 1 January 2004 and 31 December 2007, 317 patients underwent hemiarthroplasty for displaced neck of femur fracture. Of these, a total of 270 patients met the selection criteria and were included in this study; 164 patients received a Moore's and 106 patients received a bipolar prosthesis. Demographic data and preoperative ambulatory status are summarised in Table 1. The 2 groups did not differ with regards to age, gender, prefracture ambulatory status and number of medical comorbidities.

Table 1. Demographic Data and Preoperative Ambulatory Status

	Moore's (n = 164)	**Bipolar (n = 106)**
Age (years)*	74.3 (65 – 85)	72.5 (65 – 85)
Female (%)	143 (87.2)	90 (84.9)
Prefracture ambulatory status		
Independent community ambulator	67	47
Community ambulant with assistive devices	47	31
Home ambulant	50	28
Number of comorbidities		
0 – 2	134	87
>2	30	19

*Values given as mean, with range in parenthesis.

At the time of review, 38 patients were lost to follow-up and 39 patients had died; 24 (14.6%) from the Moore's group and 15 (14.2%) from the bipolar group. There were no statistically significant differences in mortality between the 2 groups of patients. In the group of 38 patients who were lost to follow-up, the prosthetic hips were minimally symptomatic as of the last follow-up. In the group of 39 patients who died, all the deaths were attributed to other medical conditions not related to the hip replacement surgery. According to telephone interviews with family members, all prosthetic hips were also minimally symptomatic till the time of death. No revision procedures were performed in both groups of patients. Mean age at time of operation was 75.4 years (range, 67 to 84) and mean duration between the primary procedure and death was 1.2 years.

A minimum of 2 years of follow-up was available for 193 of the surviving patients who were available for review; 118 in the Moore's group and 75 in the bipolar group. Mean age at time of operation was 73.7 years (range, 65 to 85). Mean duration of follow-up for this group of patients was 4.1 years (range, 2.1 to 5.2).

Postoperatively, a series of subjective assessments were made including pain, satisfaction with the operation, the Modified Harris hip score[11] and Oxford hip score.[12] The final score is multiplied by a factor of 1.11 to obtain a percentage. A score of 90 to 100 is considered excellent, 80 to 90 good, 70 to 80 fair and <70 poor. The Oxford hip score is a patient-centred questionnaire designed to assess functional ability and pain from the patient's perspective. It is calculated from responses to 12 questions on activities of daily living (ADL). The minimum score of 12 indicates normal function and the maximum of 60 the most severe disability. Other variables obtained included length of stay and postoperative complications.

The patients were reviewed postoperatively at 2 weeks, 6 weeks, 3 months, 6 months, 1 year and then annually after that. Average follow-up for the unipolar and bipolar groups were 4 and 4.25 years respectively. Standard anteroposterior pelvis and lateral hip radiographs were obtained at each visit. These were analysed specifically with regards to acetabular erosion and component migration. Acetabular erosion was evaluated radiographically by the grading system shown in Figure 1. This measures the change in thickness of the acetabular cartilage compared with the immediate postoperative radiograph. Vertical and horizontal acetabular migration was assessed by measuring the vertical distance from the center of the uni or bipolar head to the interteardrop line and the horizontal distance from the centre of the cup to the ipsilateral teardrop, respectively.[13] Patients were also evaluated for dislocation rate and need for any revision procedure.

Data was analysed using Statistical Package for the Social

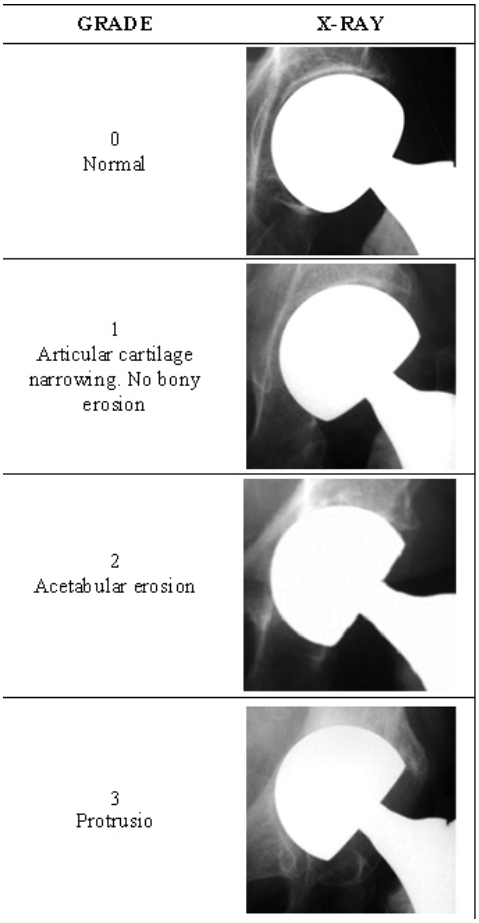

Fig.1. Grading system for acetabular erosion.

Sciences package (SPSS, Chicago, Illinois). The chi-square test was used to compare the groups with respect to hip pain and patient satisfaction. The Mann-Whitney U test was used to compare Modified Harris hip score and Oxford hip score. Fisher exact test was used to assess mortality, revision and complication rates. The student t-test was used to assess acetabular migration. The level of significance was set at $P < 0.05$.

Results

Sixty-six percent of patients who had a bipolar prosthesis reported minimal or no pain at follow-up compared to 65% of patients who had a Moore's prosthesis. This is however not statistically significant at the 5% level. Clinical outcome in terms of patient satisfaction, Modified Harris hip score and Oxford hip score did not differ significantly as well (Table 2). Analysis of data was on an 'intention-to-treat' basis. The outcomes of pain and satisfaction with operation were categorised as yes or no; patients that died or who were lost to follow-up were included in the 'yes' group with regards to pain and the 'no' group with regards to satisfaction.

Table 2. Outcome and Functional Scores

	Moore's (n = 164)	**Bipolar (n = 106)**	***P* Value**
No or mild pain (%)	107 (65.2)	70 (66.0)	0.77†
Satisfied with operation (%)	110 (67.1)	73 (68.9)	0.65†
Harris hip score*	78.7 (55 – 92)	79.3 (54 – 90)	0.45‡
Oxford hip score*	25.8 (12 – 48)	24.9 (12 – 48)	0.23‡

*Values are given as mean, with range in parenthesis.
†Chi-square test.
‡Mann-Whitney U test.

To determine whether the results were influenced by age, gender and prefracture ambulatory status, we performed logistic regression to adjust for these potential confounding factors. After adjustment for these factors, there were still no significant differences between the 2 groups for pain, satisfaction, Modified Harris hip score and Oxford hip score.

Acetabular erosion was observed in 3 patients belonging to the Moore's group but not in the bipolar group. Of these 3 patients, 2 required a revision arthroplasty for severe pain associated with acetabular erosion. Duration between surgery and revision were 2.4 and 2.7 years for these 2 patients. After the revision procedure, they had markedly improved Modified Harris hip scores and Oxford hip scores. One patient from the bipolar group required revision for periprosthetic fracture 1.5 years postoperatively. The Moore's group showed a mean cranialisation of 2.5 mm (range, 0 to 5) and mean medialisation of 2.1 mm (range, 0 to 4) of the prosthesis head compared to a mean cranialisation of 1.7 mm (range, 0 to 2) and a mean medialisation of 1.5 mm (range, 0 to 2) for the bipolar group. No cases of femoral stem loosening were noted in both groups. There were no significant differences with respect to acetabular erosion, component migration and revision rates between the 2 groups.

Postoperative complications and length of stay were identical as well (Table 3).

One patient who underwent a Moore's hemiarthroplasty suffered a dislocation in the early postoperative period after turning awkwardly in bed. There was no additional instability after a successful closed reduction. There were no cases of dislocation in the bipolar group.

Discussion

Hemiarthroplasty is the most commonly performed operation for displaced femoral neck fractures in the elderly. The aim of our study is to compare unipolar (Moore's) and bipolar hemiarthroplasty looking specifically for differences in 1) pain and functional hip scores; 2) rates of acetabular

Table 3. Postoperative Complications

	Moore's (n = 164)	Bipolar (n = 106)	*P* Value*
Dislocation	1	0	0.375
Deep vein thrombosis	9	5	0.446
Pulmonary embolism	1	1	0.714
Wound infection	3	2	0.725
Pneumonia	4	2	0.318
Urinary tract infection	5	4	0.217
Myocardial infarction	1	2	0.146
Pressure sores	1	2	0.324

*Fisher's exact test.

erosion, component migration and revision surgery; and 3) rates of postoperative morbidity. Patients with significant cognitive impairment and those who were non-ambulant prefracture were specifically excluded because many studies have shown that these patients have a poor prognosis with respect to survival and function.[10,14,15]

There are several limitations to this study. First, it is a retrospective study with all the problems associated with this methodology. Although the 2 groups appear similar in terms of demographic data, the patients were not randomly assigned to one of the implant groups. Hence, unmeasured confounders may exist that could have biased the results. Second, a fairly large number of patients were either lost to follow-up or had passed away. Third, the mean duration of follow-up was only slightly more than 4 years. Clearly, a longer follow-up is required to determine rates of acetabular erosion, component migration and revision surgery.

No significant differences in terms of pain, patient satisfaction and functional hip scores can be demonstrated between patients treated with a Moore's or bipolar hemiarthroplasty in our study. Evidence in the literature so far supports our findings. To date, both retrospective[5,6] and prospective studies[3,16,17] have not demonstrated a significant difference in functional outcome between the 2 groups.

One of the major complications associated with hemiarthroplasty is painful acetabular erosion. In theory, the second articulation in a bipolar arthroplasty would increase the range of motion and decrease native acetabular wear. The polyethylene may also result in the release of wear debris, which may lead to osteolysis and subsequent component migration. However, our study did not demonstrate a significant difference in the incidence of acetabular erosion or component migration between the 2 groups of patients. The theoretical advantages of a bipolar implant also have not been borne out by other clinical studies.[4,18] Reported rates of acetabular erosion ranged from 2.2% to 36% for unipolar designs and 0% to 26% for bipolar designs.[19] Dalldorf et al reviewed the histologic specimens in patients who were having a revision of a hemiarthroplasty and compared them with age-matched controls. Progressive degeneration was found to correlate directly with the duration of articulation of the implant with the acetabulum but not the type of implant. The fate of the cartilage that had articulated with the unipolar prosthesis was similar to that of the cartilage that articulated with the bipolar prostheses.[20] In our series, we had no cases of symptomatic or radiographic loosening. No revisions were required in either group for loosening.

Rates of postoperative morbidity were comparable between the 2 groups with no statistically significant differences (Table 3). Many studies in the literature also support our findings. Hudson et al, in an 8-year retrospective review of 90 unipolar and 48 bipolar hemiarthroplasties showed no statistically significant differences in the rates surgical or medical complications.[4] Calder et al, in a prospective and randomised 2-year trial comparing unipolar and bipolar prosthesis in octogenarians, found no difference in the complication rates as well.[3]

All studies have found that bipolar hemiarthroplasty has a higher cost than unipolar hemiarthroplasty.[5,8] With rising medical costs, this adds to the economic burden of caring for hip fracture patients. Our results have not shown a significant difference between a Moore's and a bipolar prosthesis regarding hip pain, functional hip scores, rates of acetabular erosion, component migration, revision surgery and complications rates. Studies conducted thus far concur with our findings. In addition, an evidence-based review of this topic conducted by Parker and Gurusamy concluded that the present literature demonstrated no difference between unipolar and bipolar hemiarthroplasty.[21] This suggests that the use of the more expensive bipolar prosthesis in elderly and premorbidly ambulant patient is not justified, particularly in our price sensitive population.

In recent years, there is also an increasing trend towards total hip arthroplasty for displaced femoral neck fractures.[19,22] In a study by Gebhard et al[23] involving 166 displaced femoral neck fractures, total hip arthroplasty demonstrated superior longevity when compared with hemiarthroplasty with and without cement. Revision rates were lower as well. In a prospective study of 89 patients with a displaced neck of femur fracture, Dorr et al[24] found that function improved with time after total hip replacement but not after hemiarthroplasty.

Conclusion

Use of the more expensive bipolar prosthesis in elderly and premorbidly ambulant patient is not justified. In view of the increasing life expectancy of the local population, further studies are required to determine long-term outcomes.

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