UNIPOLAR VERSUS BIPOLAR HEMIARTHROPLASTY FOR ELDERLY PATIENTS WITH FEMORAL NECK FRACTURES: A META-ANALYSIS

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ABSTRACT

Aims*: To evaluate the effectiveness of hemiarthroplasty for elder with femoral neck fractures.*

Materials and methods*: Randomized Controlled Trials and Controlled Clinical Trails were identified from corresponding database.*

Results*: Bipolar group has advantage at the hip mobility in 6 months postoperatively.*

Conclusions*: Bipolar hemiarthroplasty can improve the hip function better.*

Key words*: elder, femoral neck fractures, unipolar hemiarthroplasty, bipolar hemiarthroplasty, meta-analysis.*

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Introduction

Femoral neck fracture is common clinically and it is especially common in the elderly. The incidence of the fracture has been increasing year after year, and the number is estimated to reach upwards of 6,300,000 by 2050 around the world each year[1].

Replacement of the femoral head is still recognized as the best scheme for elderly displaced femoral neck fracture, despite its controversial[2]. Hemiarthroplasty is a procedure in which the head and neck of the femur are replaced with a prosthesis, but the acetabulum is not modified.

Hemiarthroplasty may be unipolar (in which the head is fixed to the stem) or bipolar (in which there is an additional polyethylene bearing between the stem and the endoprosthetic head component).

Older systems such as the Moore were unipolar arthroplasties which did not offer modularity between the head and the stem. Modern hip fracture arthroplasty systems offer modularity for both unipolar and bipolar arthroplasties. In theory, the second articulation in a bipolar arthroplasty would increase the range of motion and decrease wear on the native acetabulum. However, the polyethylene may also result in the release of particulate wear debris, which may lead to osteolysis[3]. Scotland University's Intercollegiate Guidelines recommend cemented unipolar hemiarthroplasty[4].

Compared with unipolar hemiarthroplasty, bipolar femoral head replacement has many advantages, including low dislocation rate[5], better postoperative activity, score and gait[6], and lower revision rate[7]. Some other randomized control trials[8] and meta-analysis[9] showed different results. The Swedish Hip Arthroplasty Register also shows bipolar femoral head replacement may increase the risk of reoperation[10].

Therefore, it remains controversial to select unipolar or bipolar femoral head replacement. Accordingly we use Cochrane System Review to evaluate the effect of unipolar or bipolar femoral head replacement from randomized and quasi-randomized control trials, from which we could get the best evidence to treat femoral neck fracture in the elderly and choose proper prosthesis.

Material and methods

A systematic literature review for randomized controlled trials that compared unipolar hemiarthroplasty with bipolar hemiarthroplasty for femoral

neck fracture was performed specifically identifying studies that documented patient complication and reoperation rates. Articles were included if they met the following criteria[1]: prospective randomized or quasi-randomized controlled trials from 1966 to 2013[2], trials enrolling elderly patients(≥65 years of age) diagnosed with an femoral neck fracture (Garden type III or type IV)[3], trials that compared a control group assigned to a unipolar femoral head replacement with bipolar for femoral neck fracture[4], normal cognitive function (a mini-mental test score of >6).

No restrictions related to the length of follow-up or languages were defined[5], the outcome measure was the available mortality rate, reoperations rate, dislocation rate, major other complication rate, or hip joint function[6], mobile before the fracture[7], no serious concomitant disease (e.g. known metastatic disease or terminal illness), or other reason for exclusion (e.g. contraindication to anesthesia or clinically significant degenerative or inflammatory arthritis).

A literature search was conducted to identify publications relating to comparing unipolar femoral head replacement with bipolar for the treatment of displaced femoral neck fractures. A librarian experienced in systematic review searching assisted with the following search strategy: ''femoral neck fractures'', ''unipolar hemiarthroplasty'', and ''bipolar hemiarthroplasty''. All searches were limited to the English language. The Ovid Medline database January 1966 to July 2013, EMBASE 1988 to 2013 Week 28, and PubMed (last search update July 2013). In addition, a Web of Science cited reference search was done based on the citations selected for inclusion. Citations that included the key terms in either the title, abstract, or article or medical subject heading (MeSH) terms were retained. Additional strategies to identify relevant studies were supplemented with manual searches of major orthopedics textbooks and bibliographies of the published articles. The search results were reviewed by two independent reviewers using a priori inclusion and exclusion criteria.

We conducted eligible data into the homogeneity test, and if it could be carried out, merger analysis; then meta-analysis were conducted using the Cochrane Collaboration's RevMan 4.2.8 software[11]. We chose to compare the event rates using odds risks (OR) as summary statistic with corresponding 95% confidence intervals (CIs).

A heterogeneity test was conducted to determine whether the results of various studies and the overall effect are consistent or not. If the effect was consistent, we use a fixed effect model, and if it was not, we analyzed data one by one, to find out the reasons, and get rid of the heterogeneity. If there was statistical heterogeneity in the data, and not clinical heterogeneity, a random effect model would be used. If the heterogeneity was too large to be carried out as a meta-analysis in the studies, descriptive analysis was used.

Results

Eligible studies

We initially identified 706 relevant reports from the year of 1966 to 2013, and found that there were 10 trials[12-21] which met the criteria of being a randomized controlled study comparing unipolar hemiarthroplasty with bipolar hemiarthroplasty for femoral neck fracture in the elderly (≥65y), of which there are seven RCTs (randomized controlled trials) and three CCTs (Controlled Clinical Trails).

Table 1 presents the characteristics of the included studies and the quality of the included studies. Table 1 Methodology Quality of Unipolar Hemiarthroplasty versus Bipolar Hemiarthroplasty for Femoral Neck Fractures.

Methodology Quality						Scales
Studies included	Study design	Randomization procedure	Allocation concealment	Assessor blinding	Loss of follow-up	
Richard A.W et al. 1995(19)	CCT	Inadequate	Unclear	Unclear	Yes	C
S.J. Calder et al. 1996(12)	RCT	Adequate	Unclear	Unclear	Yes	B
Charles N.C et al. 1998(13)	RCT	Adequate	Adequate	Adequate	Yes	A
J.N.S Davison et al. 2001(15)	RCT	Adequate	Unclear	Unclear	Yes	B
Frank J.R et al. 2003(14)	RCT	Adequate	Unclear	Adequate	Yes	B
Benjamin J et al. 2010(16)	RCT	Adequate	Unclear	Unclear	Yes	B
Mostafa A et al. 2011(20)	CCT	Inadequate	Unclear	Unclear	Yes	C
Carl J.H et al. 2011(17)	RCT	Adequate	Adequate	Unclear	Yes	B
Bhushan M.S et al. 2011(18)	CCT	Unclear	Unclear	Unclear	Yes	B
Anders E et al. 2011 (21)	RCT	Inadequate	Unclear	Unclear	Yes	C

Meta-analysis results

Eight reports[12-19], on a total of 1465 patients, provided mortality at 1 year postoperatively. We found significant heterogeneity (P=0.0001 <0.05) between those studies, so in the figure it was used as a random effect model. The mortality rate at 2 years postoperatively in unipolar hemiarthroplasty group was not different to that in bipolar hemiarthroplasty group. (OR=1.33, 95% CI=0.67, 2.63) (Fig 1).

Seven of the studies[12-15,17,19,21], on a total of 1668 patients, covered dislocation at 1year postoperatively. There was no significant heterogeneity (P=0.98 >0.05) between studies, so in the figure we used a fixed effect model. We found that it had no difference between various studies on dislocation rate at 1year postoperatively of unipolar versus bipolar hemiarthroplasty (OR=1.01, 95% CI=0.54, 1.92) (Fig. 2).

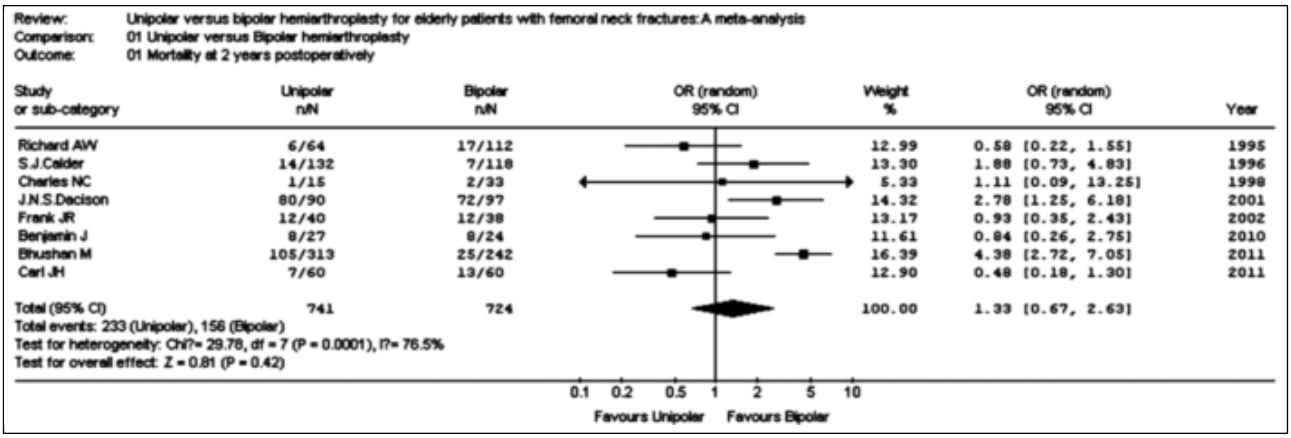

Figure 1: Unipolar versus bipolar hemiarthroplasty on mortality at 2 years postoperatively.

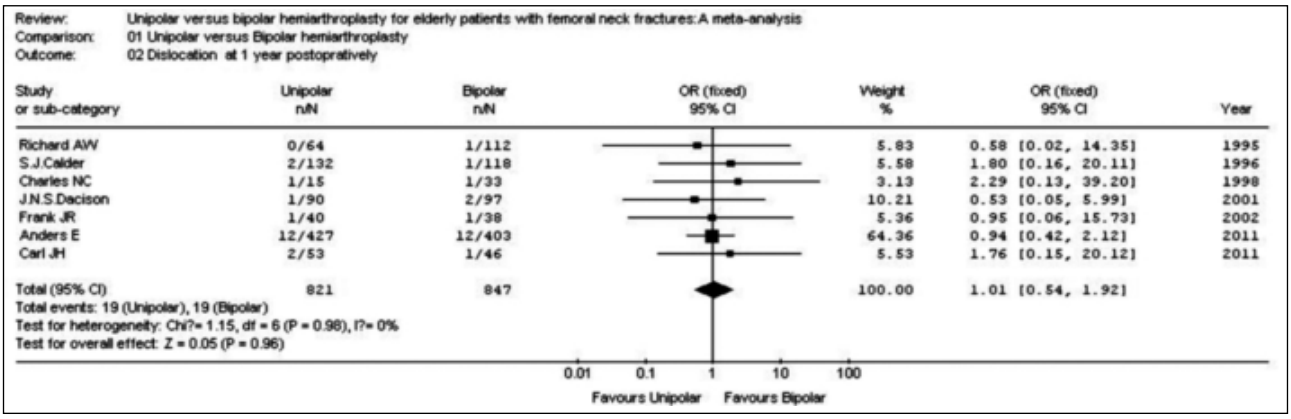

Figure 2: Unipolar versus bipolar hemiarthroplasty on dislocation at 1year postoperatively.

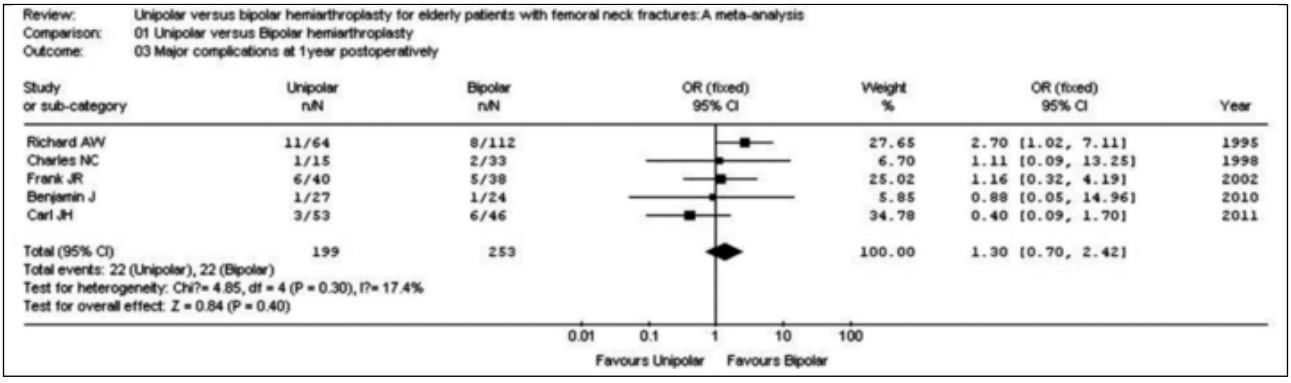

Figure 3: Unipolar versus bipolar hemiarthroplasty on major complications at 1 year postoperatively.

Because the rate of dislocation is one of the most important major complications, we choose it as one of the measurement.

Five of the studies[13,14,16,17,19], on a total of 452 patients, showed major method-related complications. There was no significant heterogeneity

(P=0.30 > 0.05) between studies, so it was used as a fixed effect model. The major method-related complications at 1 years postoperatively in unipolar hemiarthroplasty group was not different form that in bipolar hemiarthroplasty group. (OR=1.30, 95% CI=0.70, 2.42) (Fig 3).

Five of the studies[14,15,17,20,21], on a total of 1281 patients, covered reoperation rate in 1 year postoperatively. There was no significant heterogeneity (P=0.20>0.05) between studies, so we used a fixed effect model. We found that it had no difference between various studies on reoperation rate at 1year postoperatively of unipolar versus bipolar hemiarthroplasty (OR=1.13, 95% CI=0.74, 1.72) (Fig. 4).

gical version (OR=0.58, 95% CI=0.42, 0.78) (41.50% versus 30.58%, respectively) (Fig 5).

Discussion

A bipolar hemiarthroplasty design has been used for the treatment of femoral neck fractures for more than 30 years. The proposed advantages of using the bipolar design rather than the conventional fixed-head designs for femoral neck fracture in elderly patients are still controversial[8,13].

This study compared the functional outcome including the incidence of hip pain, and recovery of ambulatory status and activities of daily living

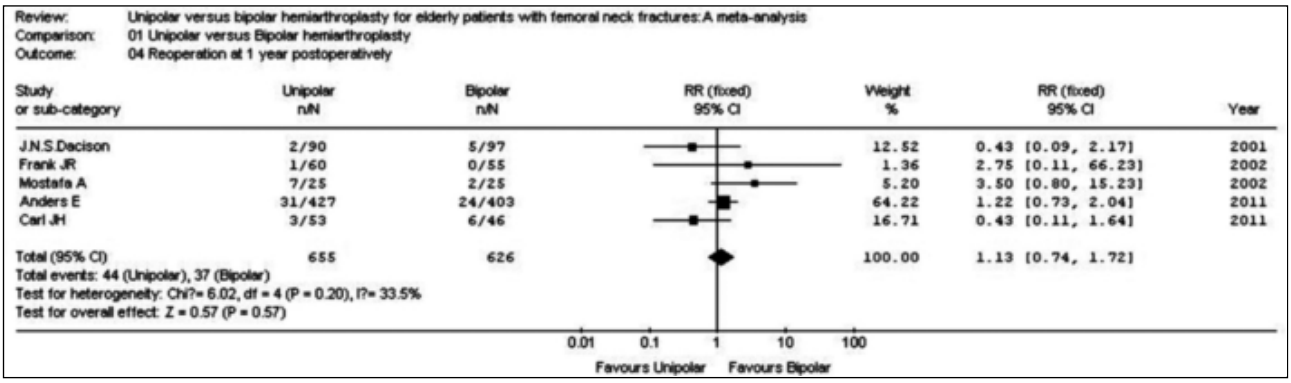

Figure 4: Unipolar versus bipolar hemiarthroplasty on reoperation in 1 year postoperatively.

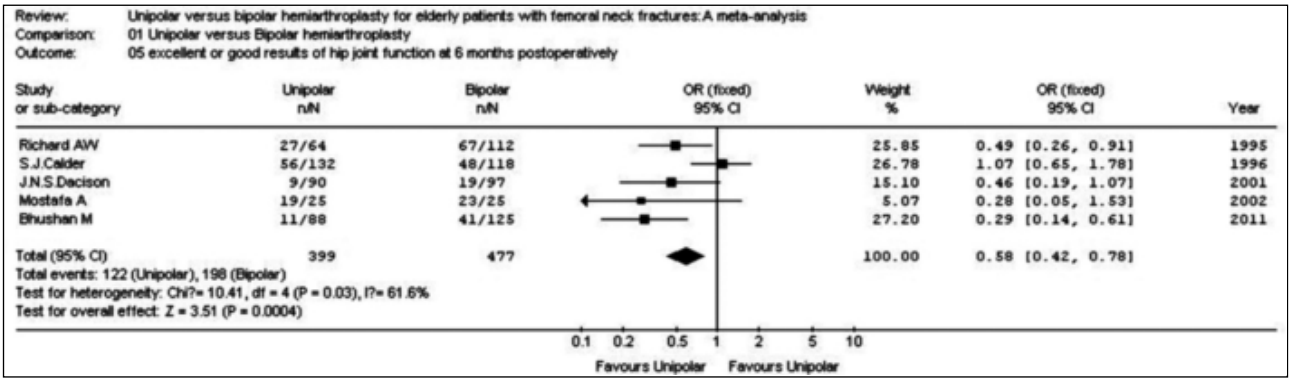

Figure 5: Unipolar versus bipolar hemiarthroplasty on excellent or good results of hip joint function at 6 months postoperatively.

Hip joint function is one of the most crucial indexes the surgeons concerning. Five of studies[12,15,18-20] related to the index. Because we found heterogeneity (P=0.02 <0.05) between those studies, we used a random effect model. At the same time we found its result is similar to that of fixed effect model, and ultimately we chose the fixed effect model. The results of excellent or good results of hip joint function at 6 months postoperatively in the 5 RCTs and CCTs[12,15,18-20], on a total of 399 patients, showed that bipolar hemiarthroplasty is superior to unipolar hemiarthroplasty for the surbetween patients treated with a unipolar versus a bipolar prosthesis after displaced femoral neck fracture. We specifically excluded institutionalized patients and patients with significant cognitive dysfunction because other studies have shown that these patients have a very poor prognosis with respect to survival and function[22-24]. By specifically defining the inclusion criteria, we were able to define a more homogeneous group, possibly more reflective of the majority of geriatric patients who sustain hip fractures than has been done in previous studies of this type.

Our study demonstrated no significant differences in rates of mortality, rates of postoperative major complications, rates of dislocation, or rates of reoperation between patients treated with a unipolar or bipolar hemiarthroplasty.

However, bipolar hemiarthroplasty is superior to unipolar hemiarthroplasty in functional results. Mortality is an important clinical criterion to compare unipolar hemiarthroplasty with bipolar hemiarthroplasty. Some arguments indicated bipolar hemiarthroplasty increased postoperative mortality.

Carl J.H et al.[1] showed that bipolar hemiarthroplasty brought a higher mortality in the first year than unipolar hemiarthroplasty, especially significantly higher among male patients, 35% (10/29) compared to 11% (10/91) among female patients. Similarly Richard A.W et al.[19] concluded that there was an incremental trend in the relative risk of death in the first 1 year after bipolar hemiarthroplasty compared with the same period after unipolar hemiarthroplasty in their prospective trial comprising 176 patients. Conversely, Bhushan M.S et al.[18] found that unipolar hemiarthroplasty gave rise to a higher mortality than bipolar hemiarthroplasty. And J.N.S Davison et al.[15] revealed a higher mean survival after bipolar hemiarthroplasty than after unipolar hemiarthroplasty. Additionally, comparing the two surgical methods, Frank J.R et al.[14] did not find significant differences between the two implants through a randomized controlled trial.

Our study demonstrated no significant differences in rates of mortality between patients treated with an unipolar or bipolar hemiarthroplasty. Our result showed that the use of bipolar hemiarthroplasty instead of unipolar hemiarthroplasty did not decrease surgical revision. However, only one result got by Anders Enocson accorded with our result[21]. In the five RCTs, there are two results showed that bipolar hemiarthroplasty had a lower postoperative revision than unipolar hemiarthroplasty[14,20]. And other two RCTs showed that unipolar hemiarthroplasty was superior to bipolar hemiarthroplasty[15,17]. However, it was still a controversy that the results would be affected by surgical techniques and status of patients.

We argue that a surgeon's skill is a prerequisite but not the only deciding factor. Several previous researches indicated surgical technique influenced clinical outcome[25-26]. Continuous hip pain leading by acetabular erosion and dislocation of hip is the main reason for reoperation. Therefore, in consideration of surgical revision, it is not important of choosing unipolar hemiarthroplasty or bipolar hemiarthroplasty. Our finding of no differences in reoperation and dislocation rates between unipolar and bipolar hemiarthroplasty is in conformity with some recently published RCTs. In that study of Carl J.H et al.[17] including 250 patients there were no differences regarding complications (such as reoperations or dislocations), hip function (Harris hip score) or health related quality of life (EQ-5D) after one year. Others, such as Calder et al.[12] in a study on 250 patients, Cornell et al.[13] in a study including 48 patients, Davison et al.[15] reporting on 187 patients and finally Raia et al.[14] in a study including 115 patients, also failed to present differences in clinical outcome or surgical complications when comparing unipolar and bipolar hemiarthroplasty in randomised studies. Subsequently, a Cochrane review from 2010 based on the seven studies published so far concluded that there is currently not enough evidence to support the use of either unipolar or bipolar prosthesis when performing a hemiarthroplasty[9].

In our study, the overall results showed better results that were statistically significant for the bipolar group over the fixed-head group in Harris hip scores, acetabular erosion and protrusion. Our results disagree with the randomized prospective study of Van Thiel et al.[27] who did not find any differences between the Moore unipolar and bipolar prostheses concerning acetabular erosion.

Our results are consistent with Yamagata et al.[28] and D'Arcy and Devas[29] who found more erosion with unipolar prosthesis, and Wetherell and Hinves[30] who reported a rate of erosion of 5.6% with the bipolar implant compared with 11% for the cemented Thompson prosthesis. Compared to unipolar hemiarthroplasty, bipolar hemiarthroplasty confers better[31-33] or similar[15] overall outcomes as well as better pain relief and function[33]. It is therefore recommended for active patients[34].

Although bipolar prostheses are more costly, they may be cost-effective given their effects on outcomes[34]. For patients aged 60 to 80 years with displaced femoral neck fractures, bipolar hemiarthroplasty was most commonly used, whereas for those aged ≥80 years, unipolar hemiarthroplasty was more popular[2]. There is no definite cut-off age for unipolar or bipolar hemiarthroplasty. Total hip replacement as a primary treatment has also been considered; its results are variable[35].

In summary, bipolar hemiarthroplasty for elderly patients with femoral neck fractures gets

better results of hip joint function than unipolar hemiarthroplasty. There is no significant difference in mortality, dislocation, major complications and reoperation between the two plants. We wait in hope that further research of multi-center and randomized controlled trials should answer which is better in mortality, dislocation, major complications and reoperation.

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