Abstract

Background: There is still controversy about the choice of treatment of displaced fractures of the neck of femur which leads the best clinical and functional outcomes. Treatment options include internal fixation, unipolar or bipolar hemiarthroplasty, or total hip replacement. Aim: The aim of this study is to find out which treatment option can lead to the best clinical and functional outcomes. Patients and Methods: Fifty one consecutive patients admitted to Makassed General Hospital with a diagnosis of a displaced fracture of the femoral neck during the year 2006 were selected. Preoperative and operative data was retrieved from inpatient hospital files. The patients then were interviewed to fill a questionnaire form. Radiological data was retrieved from inpatient hospital files and outpatient files upon latest follow up visit in clinic. Functional outcomes were assessed with use of Harris hip score. The main clinical measures were mortality and a reoperation. Results: Postoperatively, Thirty three patients (89.2%) e ither returned to the functional level that they had had before the fracture or used only a cane, which they had not needed before. Conclusion: In our study, the bipolar hemiarthroplasty has served us well. Two-year results of total hip replacement appeared to be better than those of bipolar hemiarthroplasty, but this finding was based on relatively small numbers of patients.

Keywords: Hemiarthroplasty for treatment of neck of femur fracture, internal fixation for neck of femur fracture, total hip replacement for neck of femur fracture.

Introduction

Fracture of the neck of femur is among the most serious medical problems affecting older group. Economically, these fractures constitute a large burden on healthcare [1].

The incidence of fracture of the neck of femur increases dramatically after the age of 70 years. Also the overall number is increasing because of increase in the mean age of the population [2, 3].

Significant mortality during the first year after a fracture of the neck of femur is documented. The aim of most methods of treatment should be early mobilization to avoid complications of recumbency [4].

There is still controversy about the choice of treatment of displaced fractures of the neck of femur [5]. Internal fixation either by multiple screws or sliding plate is associated with less operative trauma but complications such as displacement of the fracture, non-union, and avascular necrosis may require revision subjecting the already high-risk patients to further revision surgery [6]. Some studies recommend internal fixation only in frail patients [5].
These complications led most surgeons to treat these fractures by hemiarthroplasty to allow full weight bearing day one after operation [7]. The results of hemiarthroplasty are initially better, but if the patient survives longer, then the function deteriorates. Failure in the form of infection, dislocation, and perioperative death happens early while increasing pain, loosening, and erosion of the acetabulum constitute the late complication [8]. The role of total hip arthroplasty for the treatment of displaced intracapsular fractures of the proximal femur in active patients is controversial. Some authors have shown that such patients, when treated with a bipolar or unipolar hemiarthroplasty, are at increased risk of developing acetabular erosion that might require later revision to a total hip replacement [8]. In fact, the results of some authors were not substantially different from those reported for elective total hip arthroplasty and were better than results reported for hemiarthroplasty [9]. However, other authors have strongly recommended avoiding total hip replacement in active elderly patients without pre-existing acetabular disease [10, 11].

There have been only few studies, which have addressed the clinical, functional and the radiological follow up outcome of patients receiving bipolar prosthesis for fracture neck of femur.

This study is designed to evaluate functional, clinical, and radiological outcomes following bipolar arthroplasty for neck of femur fractures.

**Patients and Methods**

This study is approved by Institutional Review Board at Makassed General Hospital in Beirut, which is a university-affiliated teaching hospital.

We searched computerized databases for all patients admitted to our hospital with a diagnosis of a displaced fracture of the femoral neck during the year 2006.

Fifty one consecutive patients were selected. Preoperative and operative data was retrieved from inpatient hospital files. The patients then were interviewed to fill a questionnaire form.

Radiological data was retrieved from inpatient hospital files and outpatient files upon latest follow up visit in clinic.

The inclusion criteria were an age of more than sixty years, the ability to walk ≥0.5 mi (≥0.8 km), the ability to live independently (without reliance on a caregiver), a nonpathological fracture, and a hip with no or minimal osteoarthritic changes.

The exclusion criteria included an age of less than sixty, medical or physical co-morbidities that limited the walking distance to <0.5 mi (0.8 km), a preexisting hip abnormality requiring total hip arthroplasty, or a pathological fracture secondary to malignant disease.

### Table 1: Shows the characteristics of the patients and details of the procedures performed. Data is presented as mean ± SD (standard deviation) or number (percentage %) as appropriate.

| Total number of patients | 51 |
|--------------------------|----|
| Age                      | 77.43 ± 7.66 |
| Gender                   |    |
| Female                   | 35 (68.6%) |
| Male                     | 16 (34.4%) |
| Prefracture mobility     |    |
| Unaided                  | 38 (74.5%) |
| Cane                     | 10 (19.6%) |
| Walker                   | 3 (5.9%)  |
| Past medical history     |    |
| None                     | 20 (39.2%) |
| Hypertension             | 14 (27.4%) |
| Diabetes                 | 3 (5.8%)  |
| Hypertension & Diabetes  | 10 (19.6%) |
| Coronary artery disease  | 2 (4.0%)  |
| Renal failure            | 2 (4.0%)  |
| Duration from admission to surgery (days) | 1.11 ± 2.16 |
| Anesthesia               |    |
| BA                       | 41 (80.4%) |
| SA                       | 4 (7.8%)  |
| GA                       | 6 (11.8%) |
| Approach                 |    |
| Posterior                | 4 (7.8%)  |
| Lateral                  | 47 (92.2%) |
| Operative time (minutes) | 94.21 ± 30.10 |

The primary outcome was hip function after more than three years from time of surgery. Functional outcomes were assessed with use of Harris hip score. The Harris hip score is a validated fifteen-item patient questionnaire on which scores range from 0 to 100 (<70 poor; 70–79 fair; 80–89 good; 90–100 excellent). The main clinical measures were mortality and a reoperation. Secondary clinical measures included fixation failure, prosthetic dislocation, and postoperative complications, including wound infection, septicemia, deep venous thrombosis, pulmonary embolism, stroke, and myocardial infarction.

The operations were performed by surgeons with similar levels of training. All patients received the same cemented femoral component. Most operations were performed through a translgluteal lateral approach with use of so-called second-generation techniques (medullary lavage, use of an intramedullary cement plug, hand-mixing of cement, use of a cement gun to deliver the cement in a retrograde fashion and to insert antibiotic-impregnated cement in all patients). No uncemented prostheses were used during the study period. Charnley components (DePuy International, Leeds, United Kingdom) were used. The group received an Elite Plus 28 mm head. The mean femoral cup (self-centering; Depuy) size used in the group was 48 mm (range, 43 to 59 mm). Postoperatively, patients were mobilized with full weight bearing the first postoperative day.

All patients received low molecular weight heparin (Lovenox 40 mg S.C daily) as prophylaxis for deep vein thrombosis; first dose initiated eight hours after the operation. All patients received three doses of a second generation cephalosporin and metronidazole as...
prophylaxis for infection, first dose administered at the induction of anesthesia.

Initial postoperative radiographs were reviewed to determine the cementing grade according to the criteria of Barrack et al. (A grade-A result was complete filling of the intramedullary canal with cement, grade B was up to 49% radiolucency at the cement-bone interface, grade C radiolucency of 50% to 99% or an incomplete cement mantle at some point along the prosthesis, and grade D was 100% radiolucency at the cement-bone interface or failure to fill the distal canal with cement).

Final radiographs done as outpatient and data retrieved from files in the clinic were analyzed with regard to acetabular erosion, femoral stem subsidence, and component migration.

Acetabular erosion was graded on the basis of its radiographic appearance as grade 0 (no erosion), grade 1 (narrowing of articular cartilage, no bone erosion), grade 2 (acetabular bone erosion and early migration), and grade 3 (protrusio acetabuli) (Fig. 1).

| Grade | Radiographic Appearance |
|-------|-------------------------|
| 0     | Normal                  |
| 1     | Narrowing of articular cartilage; No bone erosion |
| 2     | Acetabular bone erosion; Early migration |
| 3     | Protrusio acetabuli     |

Fig. 1 Illustration depicting the acetabular erosion grading system following hemiarthroplasty.

All patients after discharge received low molecular weight heparin (Lovenox 40 mg S.C daily) for 35 days and pain killers when needed.

Statistical Analysis
SPSS version 10.1 was used for descriptive statistical analysis.

Results
Fifty one patients were enrolled in the study. All patients had a unilateral intracapsular hip fracture after falling from standing position to ground level. The mean age (years) of the patients was (77.43 ± 7.66), all patients were at least sixty years old. Thirty five patients (68.6%) were females. Thirteen patients (25.5%) used a walking aid (cane or walker) for long distances (>1 km) prior to fall down. Thirty one patients (60.8%) were taking some form of regular medication prior to the fracture. The mean duration from admission to surgery (days) was (1.11 ± 2.16). Forty one patients (80.4%) received block anesthesia. All patients received the same cemented femoral component. Most operations were performed through a transgluteal lateral approach (92.2%) with use of so-called second-generation techniques. All operations were performed by surgeons with similar level of training. The mean operative time (minutes) was (94.21 ± 30.10) (Table 1). Thirty five patients (68.6%) needed blood transfusion preoperatively. Thirty five patients (68.6%) were ambulated by physiotherapist day one after surgery. The rest were ambulated on the second and third days after surgery. Two patients (3.9%) ambulated after three months due to medical complications postoperatively. The mean duration from surgery to discharge from hospital (days) was (6.35 ± 2.95). Postoperatively six patients developed deep vein thrombosis (DVT). Two patients developed DVT one month after surgery, one patient two months after surgery, two patients three months after surgery, and one patient six months after surgery. These six patients were all treated medically without any further complications. Two patients (3.9%) developed type I postoperative infection and received medical treatment in the form of IV and oral antibiotics. No patient developed hip dislocation. No patient underwent additional hip surgery.

The mortality rate after one year from surgery was 15.7%. At the time of latest follow up, (>1000 days), fourteen patients were dead of causes unrelated to the hemiarthroplasty leaving thirty seven patients for latest functional and radiological analysis.

The results of the patient questionnaires completed at latest follow up are summarized in Table 2.

Cementing grade was assessed on the immediate postoperative radiographs according to the criteria of Barrack et al. Thirty patients (81.1%) had Grade A. Seven (18.9%) patients had grade B.

Radiographic data available at the latest follow up after a
mean duration of twenty four months showed no detectable femoral stem subsidence or migration. Acetabular erosion (Grade 1) was seen in twelve patients (32.4%).

Table 2 Functional outcome of patients at latest follow up. Data is presented as mean ± SD (standard deviation) or number (percentage %) as appropriate.

| Pain          |        |        |
|---------------|--------|--------|
| None          | 17     | (45.9%)|
| Slight        | 8      | (21.6%)|
| Mild          | 7      | (18.9%)|
| Moderate      | 4      | (10.8%)|
| Marked        | 1      | (2.7%) |
| Support       |        |        |
| None          | 19     | (51.4%)|
| Cane (long walks) | 7   | (18.9%)|
| Cane (most of time) | 7  | (18.9%)|
| Walker        | 4      | (10.8%)|
| Distance walked |      |        |
| Unlimited     | 21     | (56.8%)|
| Six blocks (30 minutes) | 6  | (16.2%)|
| 2-3 blocks (10-15 minutes) | 3  | (8.1%) |
| Indoors only  | 4      | (10.8%)|
| Bed and chair only | 3  | (8.1%) |
| Limp          |        |        |
| None          | 18     | (48.6%)|
| Slight        | 11     | (29.7%)|
| Moderate      | 5      | (13.5%)|
| Severe or unable to walk | 3  | (8.1%) |
| Activities-shoes, socks |      |        |
| With ease     | 10     | (27%)  |
| With difficulty| 15 | (40.5%)|
| Unable to fit or tie | 12 | (32.4%)|
| Stairs        |        |        |
| Normally without using a railing | 12 | (32.4%)|
| Normally using a railing | 17 | (45.9%)|
| In any manner | 1      | (2.7%)  |
| Unable to do stairs | 7  | (18.9%)|
| Public transportation |      |        |
| Able to use transportation | 20 | (54.1%)|
| Unable to use transportation | 17 | (45.9%)|
| Sitting       |        |        |
| Comfortable, ordinary chair for one hour | 32 | (86.5%)|
| On a high chair for 30 minutes | 3  | (8.1%)  |
| Unable to sit comfortable on any chair | 2  | (5.4%)  |
| Harris score  |        |        |
| 72.25 (19.82)|        |        |

Discussion
Displaced intracapsular fracture of the femoral neck can be treated with internal fixation, unipolar or bipolar hemiarthroplasty, or total hip replacement [12]. The trend in our hospital is to treat any type of intracapsular hip fracture with bipolar arthroplasty.

In a meta-analysis, Bhandari et al. concluded that arthroplasty was associated with lower revision rates but a higher prevalence of infection, greater blood loss, and longer operative time when compared with internal fixation. In this report, no distinction was made between the use of hemiarthroplasty and total hip replacement [13].

When our results were compared to “reduction and fixation” of intracapsular fracture of the femoral neck, this latter was associated with a high rate of revision surgery (39%; p<0.05) and an inferior functional outcome (20.1 ± 4) [12-14]. Other recent randomized studies have also demonstrated high reoperation rate (34% to 43%) following reduction and fixation of displaced intracapsular hip fractures [15-17]. The most common reasons for the reoperations were fixation failure and nonunion. Although osteonecrosis is a well recognized complication of this fracture, it is not the most common cause of reoperations [12]. Our results were associated with greater blood loss (p<0.0001), longer operative time (94.21 ± 30.10), but lesser prevalence of infection (p = 0.298).

This trend was particularly evident for younger patients (sixty to seventy-four years old). Although reduction and fixation had the lowest acute-admission costs (with less expensive implants, shorter operative time, and shorter initial hospital stays), the greatly increased need for readmissions and reoperations resulted in this management option having the highest costs overall [12].

Other randomized studies included patients with limited mobility or cognitive function, and it is often assumed that healthy older patients have a lower complication rate following reduction and fixation. However, in a study of a healthy group of patients, reduction and fixation had a failure rate similar to those reported in the other studies. The poorer functional outcome was particularly marked in the younger patients. Whereas fixation failures commonly occurred soon after the surgery, there might be disproportionately larger numbers of failures of the arthroplasties beyond the current follow-up period of two years. An additional potential confounding variable is the experience of the surgeons who performed the internal fixation procedures compared with that of the surgeons who did the arthroplasties [12].

In our study, the bipolar hemiarthroplasty has served us well. Postoperatively, Thirty three patients (89.2%) either returned to the functional level that they had had before the fracture or used only a cane, which they had not needed before. The bipolar hemiarthroplasty provided a functional range of motion and adequate motor power. Only one patient (2.7%) had major pain in the hip at the time of follow-up.

It must be noted that in our study the length of follow up averaged thirty six months, and the longest that any patient was followed was eighty-five months [18]. Thus, we cannot compare our results with those of studies in which the hips were followed for five to ten years. Still, there has been no significant deterioration in our results in terms of hip score, maintenance of joint space, and absence of protrusio acetabuli.

Radiographic data available at the latest follow up after a mean duration of thirty six months showed no detectable femoral stem subsidence or migration.
### Table 3 Comparisons of morbidity and mortality rates.

|                         | Our study | Hemiarthroplasty [12] | Internal fixation [1] | Total hip replacement [1] | P-value |
|-------------------------|-----------|-----------------------|-----------------------|--------------------------|---------|
| **Total number of patients** | 51        | 111                   | 118                   | 69                       |         |
| **Blood transfusion**    |           |                       |                       |                          |         |
| No                      | 16 (31.4%)| 93 (84%)              | 89 (75%)              | 46 (67%)                 | <0.0001 |
| Yes                     | 35 (68.6%)| 18 (16%)              | 29 (25%)              | 23 (33%)                 | *+§     |
| 1 Unit                  | 9 (25.7%) | 26 (74.3%)            |                       |                          |         |
| 2 Units                 |           |                       |                       |                          |         |
| **DVT**                 | 6 (11.8%) | 0                     | 4 (3%)                | 4 (6%)                   | 0.074 § |
| **Infection**           | 2 (3.9%)  | 4 (4%)                | 8 (7%)                | 3 (4%)                   | 0.999 *§|
| **Septicemia**          | 1 (2%)    | 1 (1%)                | 2 (2%)                | 1 (1%)                   | 0.999* §|
| **Stroke**              | 1 (2%)    | 3 (3%)                | 4 (3%)                | 2 (3%)                   | 0.999* §|
| **Myocardial infection**| 3 (5.9%)  | 4 (4%)                | 1 (1%)                | 2 (3%)                   | 0.043 + |
| **Pulmonary disease**   | 2 (3.9%)  | 5 (5%)                | 2 (2%)                | 1 (1%)                   | 0.313+§ |
| **Others**              | 2 (3.9%)  | 3 (3%)                | 7 (6%)                | 4 (6%)                   | 0.999*  |
| **Hip dislocation**     | 0         | 3 (3%)                | 5 (4%)                | 3 (4%)                   | 0.05**+ |
| **Additional hip surgery**| 0        | 6 (5%)                | 46 (39%)              | 6 (9%)                   | 0.05**+ |
| **Deaths**              | 14 (27.5%)| 18 (16%)              | 18 (15%)              | 6 (9%)                   | 0.0001 *+§|

* Test result between our study and Hemiarthroplasty. + Test result between our study and internal fixation. § Test result between our study and Total hip replacement.

### Table 4 Functional outcome of patients undergoing hemiarthroplasty compared to those undergoing total hip replacement.

|                         | Our study | Total hip replacement [12] | P-value |
|-------------------------|-----------|-----------------------------|---------|
| **Total number of patients** | 37        | 99                          |         |
| **Pain**                |           |                             |         |
| None                    | 17 (45.9%)| 77 (77.8%)                  | 0.0001  |
| Slight                  | 8 (21.6%) | 15 (15.2%)                 |         |
| Mild                    | 7 (18.9%) | 3 (3%)                      |         |
| Moderate                | 4 (10.8%) | 4 (4%)                      |         |
| Marked                  | 1 (2.7%)  | 0 (0%)                      |         |
| **Support**             |           |                             |         |
| None                    | 19 (51.4%)| 81 (82%)                    | 0.0001  |
| Cane (long walks)       | 7 (18.9%) | 13 (13%)                    |         |
| Cane (most of time)     | 7 (18.9%) | 2 (2%)                      |         |
| Walker                  | 4 (10.8%) | 3 (3%)                      |         |
| **Social dependence**   |           |                             |         |
| Independent in own home | 25 (67.6%)| 82 (83%)                    | 0.0001  |
| Own home support        | 12 (32.4%)| 13 (13%)                    |         |
| Sheltered housing       | 0         | 4 (4%)                      |         |

### Table 5 Functional outcome of patients undergoing hemiarthroplasty compared to those undergoing internal fixation and total hip replacement.

|                         | Our study | Hemiarthroplasty [12] | Internal fixation [12] | Total hip replacement [12] | P-value |
|-------------------------|-----------|-----------------------|-----------------------|--------------------------|---------|
| **Total number of patients** | 37        | 65                    | 110                   | 66                       |         |
| **Pain**                |           |                       |                       |                          |         |
| 20.5 (23.3)             | 20.5 (5)  | 19.7 (6)              | 20.9 (5)              |                          | 0.999   |
| 0.837                   | 0.918     |                       |                       |                          |         |
| **Walking**             | 24.3 (34.1)| 16.2 (6)            | 16.5 (6)              | 19.3 (6)                 | 0.155   |
| 0.168                   | 0.379     |                       |                       |                          |         |
| **Function**            | 22.2 (32.0)| 19.3 (5)            | 20.1 (4)              | 21.2 (4)                 | 0.585   |
| 0.691                   | 0.835     |                       |                       |                          |         |

Factors such as the patient’s age, the length of follow-up, the patient’s level of activity, the position of the stem, and
the cementing technique all play a role in such results.

In terms of morbidity, the rates in our study were consistent with those of previous studies on hemiarthroplasty [12] except for DVT (11.8%) and need for perioperative blood transfusion (68.6%; p<0.0001). The rate of dislocation and reoperation was zero in our study which is significant (p<0.05) compared to previous studies on hemiarthroplasty [12] (3% and 5%, respectively).

The mortality rate was high in our group of patients (27.5%) compared to previous studies on hemiarthroplasty [19] (16%) at two years after surgery.

Relief of pain and early mobilization and restoration of function were achieved. Loosening and loss of acetabular bone were not major problems.

When our results were compared to those following total hip replacement [19] for management of intracapsular hip fractures, the functional outcome at two years was significantly better following total hip replacement (0.0001) but the rate of dislocation and reoperation was higher (4% and 9% respectively; p<0.05).

Table 3 shows the results of comparisons of morbidity and mortality rates between our study and a randomized comparison of reduction and fixation, bipolar hemiarthroplasty, and total hip arthroplasty for treatment of displaced intracapsular hip fractures in healthy older patients.

Dislocation is the major concern after primary total hip arthroplasty for the treatment of intracapsular femoral neck fractures. Berry et al. demonstrated a 1.8-fold increased hazard estimate of dislocation risk when the preoperative diagnosis of hip fracture was compared with osteoarthritis [20].

In one study the best clinical and functional outcomes were observed after total hip replacement. This has not been a popular method of treating these fractures in the past, at least in part because of a perception that it is associated with an unacceptably high rate of prosthetic dislocation. But a recent meta-analysis showed a mean rate of dislocation of 6.9%. This is certainly higher than what is expected after arthroplasty for primary osteoarthritis, but we believe that it is still acceptably low [21].

Table 4 and table 5 summarize the functional and hip scoring of patients undergoing hemiarthroplasty compared to those undergoing internal fixation and total hip replacement.

In the study by Dorr et al., eighty-nine patients with a femoral neck fracture were prospectively randomized to receive total hip arthroplasty with cement, hemiarthroplasty with cement, or hemiarthroplasty without cement. After a minimum duration of follow-up of two years, there was no difference between the results associated with total hip arthroplasty with cement and hemiarthroplasty with cement but the results associated with hemiarthroplasty without cement were poor. Function improved with time after total hip replacement but not after hemiarthroplasty [22].

In a retrospective study of 166 displaced femoral neck fractures, Gebhard et al. found that total hip arthroplasty demonstrated superior longevity when compared with hemiarthroplasty with and without cement. After a mean duration of follow-up of fifty-six months, the revision rate was 2.2% after total hip replacement, 7.9% after hemiarthroplasty with cement, and 13% after hemiarthroplasty without cement. Pain was the main reason for revision in two-thirds of the patients managed with hemiarthroplasty [23].

On the basis of our findings, bipolar arthroplasty with cement is a treatment of choice in intracapsular neck of femur fractures. Two-year results of total hip replacement appeared to be better than those of bipolar hemiarthroplasty, but this finding was based on relatively small numbers of patients; hence, other important differences between the treatment groups could not be ruled out.

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