Dual mobility cup as a treatment of displaced femoral neck fractures in elderly: stability and function

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Received: 10 October 2017
Revised: 1 November 2017
Accepted: 22 November 2017
Published: 16 October 2021

The Egyptian Orthopaedic Journal 2021, 56:95–99

Background
The main goal in the treatment of femoral neck fractures in the elderly is to enable early mobilization. Hemiarthroplasty is considered the gold standard line of treatment. In the past decade, total hip replacement (THR) was introduced to the orthopedic community with the advantage of better pain relief and functional outcome. However, the reported dislocation rates after THR in femoral neck fractures remained higher than the rates after hemiarthroplasty. Nowadays, there is renewed interest in dual mobility cups to solve the problems of hip instabilities for various reasons. Dual mobility cups aim to decrease the dislocation rate by associating two articular surfaces: one with a larger diameter situated between a metallic cup and a polyethylene insert, thus utilizing the concept of a large head size to reduce dislocation, and the other one with a smaller diameter situated between the femoral head and the retentive polyethylene insert to achieve more mobility. The authors believe that the results of the dual mobility concept after femoral neck fractures are under-reported, with few papers discussing the outcome specifically in the Egyptian population.

Aim
This study was carried out to assess the dislocation rate and clinical results for cemented THR with a dual mobility cup as the treatment of femoral neck fractures in elderly patients, after a minimum period of 1 year.

Settings and design
A prospective case series study was carried out at El Hadara University Hospital, Alexandria University.

Patients and methods
This study included 31 patients (32 hips) with displaced femoral neck fractures who were admitted to El Hadara University Hospital, Alexandria, Egypt. Their mean age was 66.6±6.3 years. There were 15 females and 16 males. All the patients were treated using a cemented dual mobility cup for THR using the standard posterior approach. Functional assessment was performed using the Harris hip score (HHS) with the assistance of physiotherapists to avoid bias.

Results
No dislocations were encountered in this series over 1 year of follow-up. The mean operative time was 136.9 min. The average blood loss was 756.3 ml. The mean HHS improved over the follow-up period from 80.3±7.9 (95% confidence interval: 74–86) at 12 weeks to an average of 92.6±11.1 (95% confidence interval: 88.7–96.5) at the 1-year follow-up. This increase in HHS was not statistically significant (P=0.143).

Conclusions
Dual mobility cup THR is a good method for the treatment of displaced femoral neck fractures in the elderly as it provides good stability, pain relief, and good function.

Keywords:
dual mobility cup, fracture neck of femur, total hip replacement

Egypt Orthop J 56:95–99

1110-1148

Introduction

Hip fractures are the most common types of fragility fractures encountered in clinical orthopedic practice [1]. None of the common orthopedic injuries account for more morbidity, mortality, and healthcare costs as proximal femoral fractures [1–3].

According to the American Academy of Orthopedic Surgeons hip fractures accounted for 350 000 annual hospital admissions in the USA. It is also anticipated that 972 000 new femoral neck fractures will occur in Europe by the year 2050 [1,3].

Despite the good results for total hip replacement (THR) in the treatment of femoral neck fractures in

the elderly, the risk of dislocation remains a reason why orthopaedic surgeons hesitate to perform a THR [4–9].

The dual mobility cup, developed by Professor Gilles Bousquet and an engineer André Rambert at the end of the 1970s, was innovative in the field of THR. Its goal was to decrease the dislocation rate by associating two articular surfaces: one with a larger diameter situated between a metallic cup and a polyethylene insert, thus utilizing the concept of using a large head size to reduce dislocation, and the other one with a smaller diameter situated between the femoral head and the retentive polyethylene insert to achieve more mobility [10,11].

This study was carried out to assess the functional and clinical results of a dual mobility cup in elderly patients with femoral neck fractures.

Patients and methods

A prospective study was approved by the local Ethics Committee of Alexandria University and an informed consent was obtained from every patient included in the study. A total of 31 elderly patients (32 hips) with displaced femoral neck fractures were admitted to El Hadara University Hospital, Alexandria, Egypt. Their mean age was 66.6±6.3 years. There were 15 females and 16 males. One of the female patients had a fracture on one side, and sustained another fracture on the contralateral side 3 months after the surgery for the initial fracture.

During assessment of history, an assessment of the preinjury mobility and dependence level as well as the cognitive state was performed. Clinical examination included evaluation of the skin condition at the fracture site and at the bony prominences, documentation of the neurological status and the distal circulation, and classification according to American Society of Anesthesiologists scoring by the anesthetists.

Patients with cognitive dysfunction, previous hip surgeries, nonunited femoral neck fractures, neuromuscular disorders, associated fractures or amputations, inflammatory arthropathies, or pathological femoral neck fractures were excluded from the study.

All the patients were treated with THR using a cemented dual mobility cup using the standard posterior approach. Intraosseous repair of the external rotators and the capsule was performed in all cases. Patients received a single dose of antibiotics on induction of anesthesia, and another dose after 24 h. The third-generation cementing technique was used in all cases.

Check postoperative radiographies were obtained the next morning, and all patients were started on mobilization with a Zimmer frame under the care of a physiotherapist. Physiotherapy was initiated as per a modified protocol used in Brigham and Women's Hospital, Boston, USA, for rehabilitation of hemiarthroplasty and THRs [12].

All patients received thromboprophylaxis for 35 days postoperatively in the form of daily subcutaneous injections of low-molecular-weight heparin (40 mg of Enoxaparin).

Patients were reviewed after 2 weeks for assessment of wounds and removal of sutures. Patients were assessed by physiotherapists at 6 weeks. Subsequent combined follow-up with orthopedics was conducted at 12 weeks, 6 months, and every 6 months for at least a year with check radiographies to detect any complication.

Functional assessment was performed using the Harris hip score (HHS) [13] with the assistance of physiotherapists to avoid bias. This was done at 12 weeks, 16 weeks, 6 months, and 1 year.

Statistical analysis used

SPSS version 20.0 (SPSS Inc., Chicago, Illinois, USA).

Results

No dislocations were encountered in this series over one year of follow-up. The mean operative time was 136.9 min [SD: 18.5, 95% confidence interval (CI): 130.4–143.4 min]. The average blood loss was 756.3 ml (SD: 251.4, 95% CI: 669.2–843.3 ml), and this was associated with an average hemoglobin reduction of 1.3 g/dl (SD: 0.76, 95% CI: 1.1–1.6 g/dl).

The HHS showed continuous improvement over time in the 28 patients who completed minimum one year of follow-up (χ^2=39.89, P=0.000) (Fig. 1).

The pain score as a part of total HHS improved from a mean of 32.8±12.7 at three months to 37.7±12.8, and this improvement was statistically significant (P=0.001).

An interesting finding was the evident retention of a wide range of motion at the final follow-up in the three planes. The mean range of motion for each direction

was compared with range of motion of normal right hip joint in adult males as reported by Roaas and Andersson [14] (Table 1). Except for abduction and internal rotation, the mean value of the regained motion was not decreased significantly from the corresponding normal value.

Complications

One patient developed deep infection (3%), which was treated eventually with radical debridement and removal of prosthesis (Girdlestone resection arthroplasty). Brooker type 3 heterotopic ossification was observed in two patients (6.5%). Deep venous thrombosis was found in two patients (6.5%): one occurred in the immediate postoperative period and the other occurred 3 months postoperatively. One patient died within the first year of follow-up due to causes unrelated to the surgery, yielding a mortality rate of 3.2% within a year.

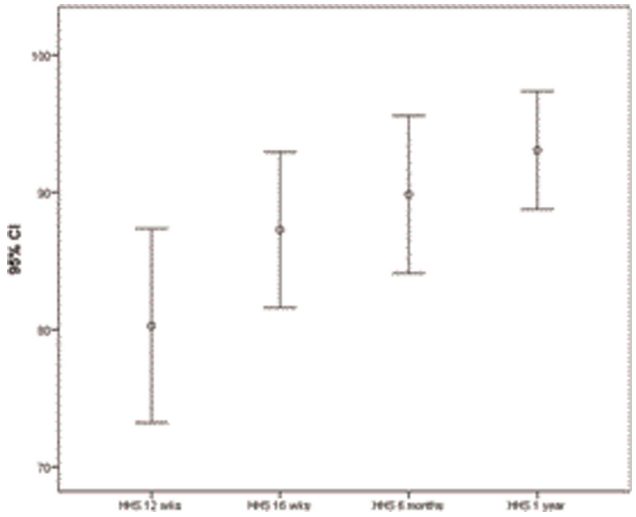
Case example

A 67-year-old retired man who is a known hepatitis C patient sustained a mechanical fall that resulted in a fracture to the left neck of the femur (Figs 2 and 3). He was active and independent before his injury, and normally mobilized without any walking aids. The surgical wound healed over 3 weeks. This delay can be explained by slight hypoproteinemia due to viral hepatitis. There was no evidence of infection or inflammation. Figure 4 shows radiographies at 3 months and at 1 year, with good position of the prosthesis and no radiological complications. The HHS increased steadily from 92 at 4 months to reach 100 at the 1-year follow-up. The final outcome was excellent according to the HHS (Fig. 5).

Discussion

It is well documented in the literature that for hemiarthroplasties, the dislocation rate is 3.8% with any surgical approach and 6.9% if the posterior approach is used [15]. For THRs, the reported dislocation rates are between 13 and 22% when the posterior approach is used, although some studies reported a 0% dislocation rate using only 28 mm heads THR [16]. There were no dislocations in our

Figure 1



Improvement in Harris hip score over time.

Table 1 Average range of motion obtained at 1 year

Hip motion	Mean ±SD	95% CI	Normal value [20]	*P* value
Flexion	116.8 ±12.5	112.4–121.3	120.3	0.14
Abduction	33.8±6.4	31.5–36.1	38.8	<0.0001
Adduction	28.5±6.5	26.1–30.9	30.5	0.11
External rotation	33.8±5.8	31.7–35.9	33.6	0.8
Internal rotation	24.5±7.3	21.9–27.1	32.6	<0.0001

CI, confidence interval.

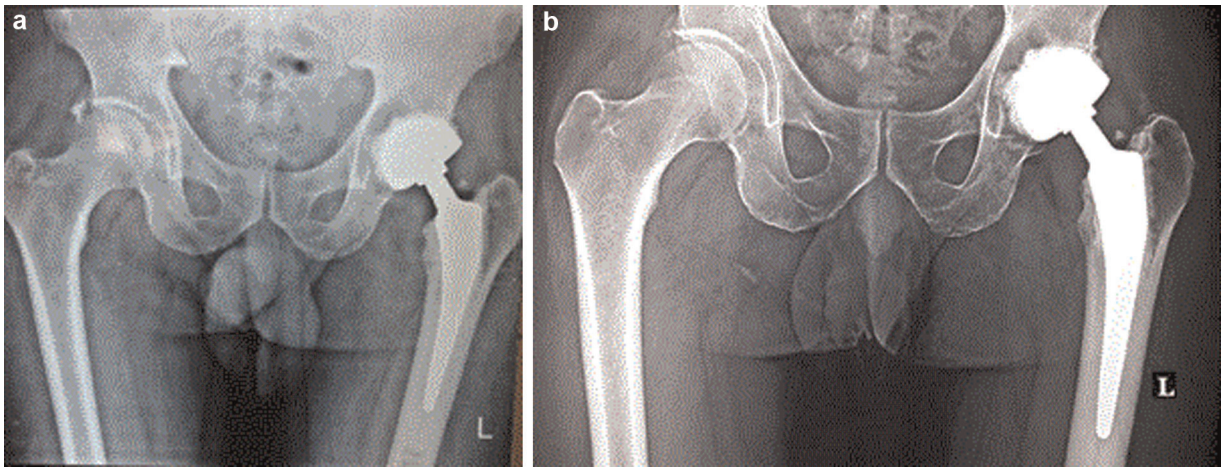
Figure 2

Preoperative radiographies showing a left femoral neck fracture.

Figure 3

Immediate postoperative radiography.

Figure 4



Radiographies at 3 months (a) and at 1 year (b), with good position of the prosthesis and no radiological complications.

Figure 5

(a, b, c) Final functional outcome at the 1-year follow-up.

current study, which is comparable or superior to hemiarthroplasty, and superior to the 1.4% dislocation rate obtained by Adam *et al.* [17] in the prospective multicenter study that involved 214 patients treated by dual mobility cups. The slight difference may be explained by the younger mean age in our study as compared to that in the Adam and colleagues study (83 years).

Dual mobility cup replacements have been extensively studied after being performed for primary osteoarthritis. In arthritic hips, the preoperative range of motion is usually limited. Dual mobility cups are known to increase range of motion; however, to our knowledge, there was no study available in the literature that analyzed the range of motion obtained postoperatively. In our study, arthritic acetabulae were excluded, which was more challenging, as the risk of dislocation would be higher due to the fact that the preoperative range of motion was within normal for the patients in the study.

The range of motion measurement was performed by the physiotherapist to avoid any bias if the surgeon evaluated the results of the surgery. The average flexion range obtained was 116.8°, and the average external rotation of 33.8° at the 1-year follow-up. The average age of the patients included in the study was 66.65 years, which is a relatively young age, and they had a relatively high functional demand. As they were Muslim patients, a high range of motion of the hip joint, specifically flexion and external rotation, was required to continue with their religious practices of praying, without compromising the stability of the prosthesis.

The overall HHS improved over the 1-year follow-up period. In a study by Blomfeldt *et al.* [18], the overall HHS was compared between two cohorts of hemiarthroplasties and THRs for femoral neck fracture treatment. Then, a detailed analysis was also carried out related to the pain component of the HHS. The overall HHS was 77.5 for hemiarthroplasty and 82.5 for THRs at 3 months. This increased to 79.4 for hemiarthroplasty and 87.2 for THRs at the 1-year

follow-up. This study shows an overall HHS of 87 at 3 months, which increased to 92.6 at 1 year. This clearly shows that dual mobility cup replacements used in our study provided a higher functional outcome at 3 months and 1 year as compared to hemiarthroplasty and conventional THRs.

One of the strengths of our study is that this was a prospective study. The functional assessment was performed by a trained physiotherapist to avoid bias of the operating surgeon. This study reported the postoperative range of motion after trauma. Previous studies presented data about postoperative range of motion only for osteoarthritis.

The limitations of the current study were the small sample size and the lack of a control group.

Conclusion

Dual mobility THR for femoral neck fractures combined the advantage of greater stability with that of better function in terms of good pain relief and near-normal range of motion.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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