Dual mobility acetabular component in revision total hip arthroplasty for persistent dislocation: no dislocations in 50 hips after 1–5 years

M. van Heumen · P. J. C. Heesterbeek · B. A. Swierstra · G. G. Van Hellemondt · J. H. M. Goosen

Received: 5 February 2014 / Accepted: 7 September 2014 / Published online: 24 September 2014 © The Author(s) 2014. This article is published with open access at Springerlink.com

Abstract

Background A dual mobility cup has the theoretic potential to improve stability in primary total hip arthroplasty (THA) and mid-term cohort results are favorable. We hypothesized that use of a new-generation dual mobility cup in revision arthroplasty prevents dislocation in patients with a history of recurrent dislocation of the THA.

Materials and methods We performed a retrospective cohort study of patients receiving an isolated acetabular revision with a dual mobility cup for recurrent dislocation of the prosthesis with a minimum follow-up of 1 year. Kaplan–Meier survival analyses were performed with dislocation as a primary endpoint and re-revision for any reason as a secondary endpoint.

Results Forty-nine consecutive patients (50 hips) were included; none of the patients was lost to follow-up. The median follow-up was 29 months (range 12–66 months). Two patients died from unrelated causes. Survival after 56 months was 100 % based on dislocation and 93 % (95 % CI 79–98 %) based on re-revision for any reason. Radiologic analysis revealed no osteolysis or radiolucent lines around the acetabular component during the follow-up period.

Conclusion The dual mobility cup is an efficient solution for instability of THA with a favorable implant survival at 56 months.

Level of evidence Level 4, retrospective case series.

Keywords Revision hip arthroplasty · Dislocation · Dual mobility cup · Implant survival

Introduction

The risk of dislocation after total hip arthroplasty (THA) varies from 0.4–8.7 % for primary procedures and from 5–20 % for revisions [1]. Many patient and surgical risk factors for dislocation are described including female gender, older age at the time of surgery, previous hip surgery and revision surgery, neuromuscular disorders, poor medical status/high American Society for Anesthesiologists score (ASA score) and a small diameter of the femoral head [2–5].

On-going research has led to the development of many different improvements in the design and technique of the THA in an attempt to reduce the rate of dislocation. If no clear malposition of prosthetic components was present, large femoral heads, acetabular augmentation rings and constrained tripolar prostheses could be used. Although all have shown a reduction in dislocation rates, the results were still unsatisfactory [5–9]. Another development was the dual mobility cup which was devised by Dr. Bousquet in the mid-1970s [10]. The dual mobility cup is a combination of two fundamental principles—(1) the smaller the head articulating against a polyethylene liner, the lower the wear rates because of low friction [11], and (2) the larger the diameter of the bearing, the greater the joint stability [12] (Fig. 1).
The application of a dual mobility cup has been described for both primary and revision THA, as well as without a reason for persistent dislocation [16, 17, 19–22] and high risk of dislocation [13, 14]. Furthermore, there are only a few reports concerning the use of this type of implant in revision cases for recurrent dislocation. Leiber-Wackenheim et al. [15] reported on a group of 59 patients with a mean follow-up of 8 years. There was one early dislocation without recurrence and all implants survived. Hailer et al. [18] described a series of 228 cases with a follow-up of 2 years. They observed a survival of 99 % (95 % CI 97–100) based on dislocation and 93 % (95 % CI 90–97) based on the revision rate for any reason.

In order to test this theoretic advantage in stability of the THA, we investigated the dislocation rate of a dual mobility cup used for revision in 49 patients (50 hips) with a history of recurrent dislocation of their THA. We hypothesized that use of this component in revision arthroplasty would decrease the risk of re-dislocation of the THA. A second aim of the study was to assess the survival of the component.

**Materials and methods**

We performed a single-center retrospective study of patients who received an isolated acetabular revision with a dual mobility cup (Avantage®; Biomet, Warsaw, IN, USA) between January 2007 and June 2011. This cup has an uncemented shell design (coated with hydroxyapatite) or a polished shell for cementation (Fig. 2). The liner is made from argon-sterilized ultra-high molecular weight polyethylene (Arcom®; Biomet). Inclusion criteria were indication for revision with a dual mobility cup for recurrent dislocation or subluxation of the prosthesis (more than two episodes) and a minimum follow-up of 1 year after revision surgery. In total, 50 consecutive hips of 49 patients (one bilateral case) were included.

Surgery was performed using a posterolateral approach with the patient lying in a lateral decubitus position.

Postoperative management consisted of immediate full weight-bearing, using crutches for support, unless the intraoperative bone quality was poor and/or the surgeon used bone impaction grafting for reconstruction of the acetabulum. In these cases, partial weight-bearing over 3 months (15 % weight-bearing during the first 6 weeks, followed by 50 % for the next 6 weeks) was advised.

The clinical and radiologic data were retrieved from patient files. Demographic parameters included gender, age, height, weight, body mass index (BMI), ASA score,
medical and surgical history, and side of planned surgery (Table 1). Primary indication and surgical history of the patients are presented in Tables 2 and 3. One patient with a history of seven surgeries prior to the revision had some traumatic dislocations of the hip prosthesis, requiring several open re-position revision surgeries. Another patient with a history of 11 surgeries prior to revision underwent several operations because of congenital hip dysplasia, followed by surgical lavage and a two-stage revision due to a joint infection of the primary THA, which was postoperatively complicated by persistent dislocation, leading to re-revision surgery. Thirty of the 50 cases had undergone two or more previous surgeries to the affected hip. In 23 cases, no previous revision surgery had been performed prior to the revision with the dual mobility cup; therefore, 27 of the procedures were re-revisions (Tables 4, 5). No additional pathologies with impact on the dislocation rate, like neurologic disorders, were found.

Data regarding the type and size of implant, fixation method, technical details (Table 6) and complications, as

| Table 1 Patient characteristics |
|---------------------------------|
| Characteristics                | N  |
| Gender                         |    |
| Male                           | 10 |
| Female                         | 39 |
| Mean height                    | 170 cm (range 153–195 cm) |
| Mean weight                    | 79 kg (range 40–120 kg)    |
| Mean BMI                       | 27.17 kg/m² (range 16.6–43.0 kg/m²), with 34 patients overweight (BMI >25) |
| Mean age at operation          | 67 years (range 32–90 years) |
| Mean ASA-score                 | 2.02 (range 1–3)            |

| Table 2 Indication primary THA |
|--------------------------------|
| Diagnosis                      | N  | %  |
| Osteoarthritis                 | 31 | 62 |
| Congenital hip dysplasia with secondary osteoarthritis | 12 | 24 |
| Medial collum fracture         | 3  | 6  |
| Femoral head necrosis (after medial collum fracture/acetabular fracture with central luxation of the femoral head) | 4 | 8 |

| Table 3 Surgical history |
|--------------------------|
| No. of surgical procedures of the affected hip before revision with the dual mobility cup | No. of patients | %  |
| 1                        | 20          | 40 |
| 2                        | 14          | 28 |
| 3                        | 6           | 12 |
| 4                        | 5           | 10 |
| 5                        | 3           | 6  |
| 6                        | 0           | 0  |
| 7                        | 1           | 2  |
| 8                        | 0           | 0  |
| 9                        | 0           | 0  |
| 10                       | 0           | 0  |
| 11                       | 1           | 2  |

| Table 4 Revision surgery for any reason |
|-----------------------------------------|
| No. of revisions for any reason, before revision with the dual mobility cup | No. of patients | %  |
| 0                        | 23          | 46 |
| 1                        | 17          | 34 |
| 2                        | 4           | 8  |
| 3                        | 4           | 8  |
| 4                        | 2           | 4  |

| Table 5 Revision surgery for instability |
|------------------------------------------|
| No. of revisions for instability, before revision with the dual mobility cup | No. of patients | %  |
| 0                        | 29          | 58 |
| 1                        | 17          | 34 |
| 2                        | 2           | 4  |
| 3                        | 2           | 4  |

| Table 6 Operative characteristics |
|-----------------------------------|
| Characteristic                  | N  |
| Operated side                   |    |
| Left                             | 24 |
| Right                            | 26 |
| Size of acetabular cup           |    |
| 48                                | 5  |
| 50                                | 19 |
| 52                                | 7  |
| 54                                | 14 |
| 56                                | 3  |
| 58                                | 1  |
| 60                                | 1  |
| Femoral head size                |    |
| 22                                | 5  |
| 28                                | 45 |
| Fixation                         |    |
| Cemented                         | 46 |
| Uncemented                       | 4  |
| Bone impaction grafting          |    |
| Yes                               | 6  |
| No                                | 44 |
well as information on any other occurring complications during the entire hospitalization, including infection, thrombosis, pulmonary embolism, hematoma, skin necrosis, nerve injury and/or death were obtained.

Postoperatively, outpatient clinic visits were routinely scheduled for radiologic (acetabular inclination angle and loosening of the cup) and clinical follow-up at 6 weeks, 3 months, and 1 year and were continued annually. Follow-up endpoints were dislocation of the THA, re-revision of the THA or death for any reason. Patients who did not attend the outpatient clinic visits for more than 1 year were contacted by telephone to ask for any dislocations or re-revisions postoperatively. When patients died, the general practitioner was contacted to obtain information on dislocations and implant re-revisions.

Descriptive statistics were presented as frequencies, and median values with ranges. Two Kaplan–Meier survival analyses were performed; one to estimate the cumulative probability of remaining free of dislocation, and the other to estimate the cumulative probability of remaining free of revision. The survival analysis was truncated when the number of patients remaining in the sample reached ten percent of the initial population. All statistical analyses were performed using STATA version 10.1 for Windows.

Results

None of the 49 patients (50 hips) were lost to follow-up. Two patients died (of unrelated causes) before final analysis. The median time from revision surgery to evaluation was 29 months (range 12–66 months).

No postoperative dislocations were observed during follow-up. At final follow-up, three of the hips revised with a dual mobility cup had been re-revised. In one case, a two stage re-revision took place because of a postoperative joint infection 7 months after surgery. The second case was also a postoperative joint infection where the prosthesis was removed and left with a Girdlestone procedure. In the third case, there was a cup loosening based on an under-sized uncemented shell (technical/surgical failure) directly after the revision and this was re-revised on the same day. In addition, three patients required re-operation with retention of the prosthesis—two of these patients required a wound revision, following debridement and early antibiotic treatment due to prolonged effusion of the wound. Tissue cultures showed a postoperative joint infection, which was managed by continuing antibiotic treatment for 3 months. During follow-up, the prosthesis could be retained and there were no signs of persistent infection. The third patient underwent re-operation due to sciatic nerve palsy. Drainage of a compressive hematoma was performed and the patient fully recovered after 4 months. Radiographic analysis revealed a mean acetabular inclination of 49° (range 31–65°). No osteolysis or radiolucent lines occurred around the acetabular component during the follow-up period.

The mean cumulative survival for remaining free of dislocation after 56 months was 100 % (Fig. 3). The mean cumulative survival for remaining free of revision for any reason after 56 months was 93 % (95 % CI 79–98) (Fig. 4).

Discussion

Implant survival in our study (93 %) was comparable with other reports in the literature [13–20]. The current study population consisted of patients with an isolated acetabular revision due to recurrent dislocation of their THA. Most previous reports show comparable favorable results [13–18]. Langlais et al. [13] reviewed the results of 88 isolated acetabular revisions (82 patients at high risk of dislocation) using cemented dual mobility cups.
with a mean follow-up of 3 years (range 2–5 years). There was one dislocation (1.1 %) and survival was 94.6 % (two cases of aseptic loosening). Gözte et al. [14] described their experience with an acetabular or total hip revision with a dual mobility cup (as used in our study) in 27 patients with a high risk of dislocation (14 cases) or a history of recurrent dislocation (13 cases). At a mean follow-up of one and a half years, there had been one dislocation of the polyethylene liner and the implant survival rate was 100 %. Leiber-Wackenheimer et al. [15] are one of the few who reported on a series of isolated acetabular revisions with an uncemented dual mobility cup in a group of 59 patients with a history of recurrent dislocations. There was one early dislocation without recurrence after a mean follow-up of 8 years. All implants survived, and no component explantations were required. Civinini et al. [16] performed a prospective study of 33 patients (33 hips) with isolated acetabular revision with a dual mobility implant as used in the current study. Indication for revision was aseptic loosening (32 cases) or malposition of the cup (one case). At a mean follow-up of 3 years, no dislocations had occurred and survival rates were 97 % (95 % CI 82–98). Philippot et al. [17] showed the results of 163 acetabular revisions with a dual mobility cup. At a mean follow-up of 5 years, there were six cases (3.7 %) of dislocation and two cases of acetabular loosening; cup survival was 96.1 % (95 % CI 93–99). Recently, Hailer et al. [18] identified 228 THA cup revisions from the Swedish Hip Arthroplasty Register in patients with persistent dislocations with a dual mobility component as used in our study. They were only able to detect re-operations. At 2-year follow-up, they observed a survival of 99 % (95 % CI 97–100) based on dislocation and 93 % (95 % CI 90–97) based on the revision rate for any reason.

In contrast with the favorable results described above and the results found in the present study, Massin and Besnier [19] performed acetabular revisions using an uncemented dual mobility cup in 23 patients and reported a re-dislocation rate of 8.7 % at a mean follow-up of 4.5 years (range 2–10 years). Guyen et al. [20] reported on a series of 54 patients, there were six cases (3.7 %) of dislocation and two cases of acetabular loosening; cup survival was 96.1 % (95 % CI 93–99). Recently, Hailer et al. [18] identified 228 THA cup revisions from the Swedish Hip Arthroplasty Register in patients with persistent dislocations with a dual mobility component as used in our study. They were only able to detect re-operations. At 2-year follow-up, they observed a survival of 99 % (95 % CI 97–100) based on dislocation and 93 % (95 % CI 90–97) based on the revision rate for any reason.

In primary THA, survival rates after use of a dual mobility component were comparable [21–23] to the results of the present study. Philippot et al. [21] reported on a large series of 384 patients operated on with a dual mobility cup at primary THA. At a mean follow-up of 15 years (range 12–20), there were 14 cases (3.6 %) of dislocation (intra-prosthetic dislocation: femoral head dislocates from liner) with an overall survival of 97 %. Bouchet et al. [22] performed a case–control study of primary THAs with use of a dual mobility cup in 105 patients, compared with the use of conventional implants in a matched group of 106 patients.

At a mean follow-up of 4.3 years (range 3.2–5.6 years) there had been no dislocations in the dual mobility group versus five dislocations (4.6 % dislocation rate) in the matched group. Survival was 100 %. In a case series of ten THA patients with cerebral palsy no dislocations were observed at 39-month follow-up [23].

The main limitations of our study are the retrospective design and the lack of long-term follow-up (median 29 months; range 12–66 months). However, most dislocations occurred in the first 3 months postoperatively [24] and most re-revisions due to re-dislocation should have been performed during the first 2 years postoperatively [25]. We truncated the survival analysis at 56 months when only five patients remained.

Another limitation of the study is the absence of detailed functional results of the THA according to a clinical scale. These data would have provided more information about the functional performance of the implant. The study also included only a relatively small number of patients (49 patients, 50 hips). However, large series of isolated acetabular revisions concentrated on patients with recurrent dislocations are relatively uncommon in the literature. The strength of our study is the well-described homogeneous patient group. The results are comparable with the few other reports on this topic. This reinforces the favorable results of this type of implant in difficult revision cases.

In conclusion, the present study demonstrates an excellent 5-year survival rate with respect to the occurrence of postoperative dislocation with a dual mobility cup in revision THA due to instability. The re-revision rate for any reason is also promising. Thus, the dual mobility cup seems to be an efficient solution in revision cases for persistent dislocation of the THA. However, longer follow-up of a larger study population is required to confirm these relatively short-term findings and before firm conclusions can be drawn.

Conflict of interest None.

Ethical standards All patients gave informed consent before inclusion into the study; the study was authorized by the institutional review board and was performed in accordance with the ethical standards of the 1964 Declaration of Helsinki as revised in 2000.

Open Access This article is distributed under the terms of the Creative Commons Attribution License which permits any use, distribution, and reproduction in any medium, provided the original author(s) and the source are credited.

References

1. van der Grinten M, Verhaar JAN (2003) Dislocation of total hip prostheses: risk factors and treatment. Ned Tijdschr Gen 147:286–290
1. Khatod M, Barber T, Paxton E, Namba R, Fithian D (2006) An analysis of the risk of hip dislocation with a contemporary total joint registry. Clin Orthop Relat Res 447:19–23
2. Byström S, Espehaug B, Furnes O, Havelin LI (2003) Femoral head size is a risk factor for total hip luxation: a study of 42,987 primary hip arthroplasties from the Norwegian Arthroplasty Register. Acta Orthop Scand 74:514–524
3. Jolles BM, Zangger P, Leyvraz PF (2002) Factors predisposing to dislocation after primary total hip arthroplasty: a multivariate analysis. J Arthroplasty 17:282–288
4. Alberton GM, High WA, Morrey BF (2002) Dislocation after revision total hip arthroplasty: an analysis of risk factors and treatment options. J Bone Joint Surg (Am) 84:1788–1792
5. Bosker BH, Ettema HB, Verheyen C, Castelein RM (2009) Acetabular augmentation ring for recurrent dislocation of total hip arthroplasty: 60% stability rate after an average follow-up of 74 months. Int Orthop 33(1):49–52
6. Williams JT Jr, Ragland PS, Clarke S (2007) Constrained components for the unstable hip following total hip arthroplasty: a literature overview. Int Orthop 31(3):273–277
7. Bouchet R, Mercier N, Saragaglia D (2011) Posterior approach and dislocation rate: a 213 total hip replacements case–control study comparing the dual mobility cup with a conventional 28 mm metal head/polyethylene prosthesis. Orthop Traumatol Surg Res 97:2–7
8. Sanders RJ, Swierstra BA, Goosen JH (2013) The use of a dual mobility concept in total hip arthroplasty patients with spastic disorders. No dislocations in a series of ten cases at midterm follow-up. Arch Orthop Trauma Surg 133:1011–1016
9. Boustead C, Goosen JH, Harris WH, Poss R, Katz JN (2003) Incidence rates of dislocation, pulmonary embolism, and deep infection during the first six months after elective total hip replacement. J Bone Joint Surg (Am) 85:20–26
10. Blom AW, Astle L, Loveridge J, Learmonth ID (2005) Replacement of arthritic hips by the Mackee-Farrar prosthesis. J Bone Joint Surg (Br) 48:245–259
11. Langlais FL, Ropars M, Gaucher F, Musset T, Chaix O (2008) Dual mobility cemented cups have low dislocation rates in THA revisions. Clin Orthop Relat Res 466:389–395
12. Götze C, Glosemeyer D, Ahrens J, Steens W, Gosheger G (2010) Die bipolare pfanne avantag in der hüftrevisionschirurgie. Z Orthop Unfall 148:420–425
13. Leiber-Wackenheim F, Brunschweiler B, Ehlinger M, Gabrion A, Mertl P (2011) Treatment of recurrent THR dislocation using of a cementless dual-mobility cup: a 59 cases series with a mean 8 years follow-up. Orthop Traumatol Surg Res 97:8–13
14. Civinini R, Carulli C, Matussi F, Nistri L, Innocenti M (2012) A dual-mobility cup reduces risk of dislocation in isolated acetabular revisions. Clin Orthop Relat Res 470:3542–3548
15. Philippot R, Adam P, Reckhaus M, Delangle F, Verdot FX, Curval G, Farizon F (2009) Prevention of dislocation in total hip revision surgery using a dual mobility design. Orthop Traumatol Surg Res 95:407–413
16. Hailer NP, Weiss RJ, Stark A, Kärholm J (2012) Dual-mobility cups for revision due to instability are associated with a low rate of re-revisions due to dislocation: 228 patients from the Swedish hip arthroplasty Register. Acta Orthop 83:556–571
17. Massin P, Bensier L (2012) Acetabular revision using a press-fit dual mobility cup. Orthop Traumatol Surg Res 96:9–13
18. Civinini R, Carulli C, Matussi F, Nistri L, Innocenti M (2012) A dual-mobility cup reduces risk of dislocation in isolated acetabular revisions. Clin Orthop Relat Res 470:3542–3548
19. Philippot R, Adam P, Reckhaus M, Delangle F, Verdot FX, Curval G, Farizon F (2009) Prevention of dislocation in total hip revision surgery using a dual mobility design. Orthop Traumatol Surg Res 95:407–413
20. Civinini R, Carulli C, Matussi F, Nistri L, Innocenti M (2012) A dual-mobility cup reduces risk of dislocation in isolated acetabular revisions. Clin Orthop Relat Res 470:3542–3548
21. Philippot R, Camilleri JP, Boyer B, Adam P, Farizon F (2009) The use of a dual-articulation acetabular cup system to prevent dislocation after primary total hip arthroplasty: analysis of 384 cases at a mean follow-up of 15 years. Int Orthop 33:927–932
22. Bouchet R, Mercier N, Saragaglia D (2011) Posterior approach and dislocation rate: a 213 total hip replacements case–control study comparing the dual mobility cup with a conventional 28 mm metal head/polyethylene prosthesis. Orthop Traumatol Surg Res 97:2–7
23. Sanders RJ, Swierstra BA, Goosen JH (2013) The use of a dual mobility concept in total hip arthroplasty patients with spastic disorders. No dislocations in a series of ten cases at midterm follow-up. Arch Orthop Trauma Surg 133:1011–1016
24. Blom AW, Astle L, Loveridge J, Learmonth ID (2005) Revision of an acetabular liner has a high risk of dislocation. J Bone Joint Surg (Br) 87:1636–1638
25. Phillips CB, Barrett JA, Losina E, Mahomed NN, Lingard E, Guadagnoli E, Baron JA, Harris WH, Poss R, Katz JN (2003) Incidence rates of dislocation, pulmonary embolism, and deep infection during the first six months after elective total hip replacement. J Bone Joint Surg (Am) 85:20–26