



## **Pinnacle® revision cup in acetabular surgery** *Results at 2 to 5 years*

Alain DALEMANS, Sascha COLEN, Marcus VAN DIEMEN, Michiel MULIER

*From the University Hospitals Leuven, Pellenberg, Belgium*

**Uncemented revision cups are widely used in revision hip arthroplasty ; they have shown good results. We report the the short term outcome with the cementless Pinnacle® revision cup.**

**All acetabular revisions using a Pinnacle® revision cup between January 2007 and March 2010 were included. In March 2012, clinical scores were determined and the latest radiographs were assessed. Revision and radiographic signs of loosening were reported as failure of the cup.**

**This study included 117 patients (118 revision cups) with a follow-up between two and five years. Five cups failed (4%). The median modified Harris Hip Score was 64 (range : 18-91).**

**Survival rates of the Pinnacle® revision cup are good in the short term follow-up. This implant appears as a safe and reliable solution for small to moderate acetabular defects.**

**Keywords :** revision hip arthroplasty ; cementless cup ; Pinnacle cup.

are various treatment options for the revision of failed acetabular components, depending on the integrity of the bony acetabulum. Bilobed acetabular components (1,13) and the use of allografted bone in addition to a revision cup have been shown to be good solutions to treat small and moderate acetabular defects. Allogenic bone grafts and trabecular metal components can be used to reconstruct the anatomy of the acetabulum and to make it possible to implant an acetabular cup. Good results have also been reported with impaction bone grafting (2,25) as well as with structural allografts (12,16). If the acetabulum is too damaged to use a conventional cup, a triflanged antiprotrusio cage is a good solution (23,24,26). Another option for small or moderate acetabular defects is the use of non-cemented revision cups, with which good results have been reported (7,9,10,11,19,28). Survival rates of 88 to 100%

### **INTRODUCTION**

Aseptic loosening is the most frequent reason for revision of a primary total hip arthroplasty (THA) (8). Less frequent reasons include infection, periprosthetic fractures, recurrent dislocations and wear. Whatever the reason, revision of a THA may be a challenging procedure, with the remaining bone structures as a major factor for success (17). There

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- Alain Dalemans, MD, resident.
  - Sascha Colen, MD, orthopaedic surgeon.
  - Marcus van Diemen, MD, resident.
  - Michiel Mulier, MD, PhD, senior orthopaedic surgeon.  
*University Hospitals Leuven, Department of Orthopaedic Surgery, Pellenberg, Belgium.*  
Correspondence : Sascha Colen, University Hospitals Leuven, Pellenberg site, Department of Orthopaedic Surgery, Weligerveld 1, 3212 Pellenberg, Belgium.  
E-mail : sascha.colen@uzleuven.be  
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Table I. — Results of other cementless revision cups in literature

| Authors                       | Mean HHS | Survival (%) | Mean follow-up | Complication rate (%) | Lost to follow-up/total number | Cups   | Defects   |
|-------------------------------|----------|--------------|----------------|-----------------------|--------------------------------|--|---|
| Gustke 2004                   | -        | 97           | 6.1 years      | 3                     | ?/166†                         | Sulzer APR or InterOP hemispherical shells (Zimmer)                              | 63% AAOS* type II<br>72% Paprosky type 2<br>22% Paprosky type 3 |
| Hendricks <i>et al</i> 2006   | 79       | 100          | 13.9 years     | 12.5                  | 8/24‡                          | 12 Harris-Galante-I and 12 Harris-Galante-II (Zimmer)                            | Not specified   |
| Wedemeyer <i>et al</i> 2008   | 83       | 88           | 82 months      | 24                    | 4/17                           | Duraloc 100 and 1200 (DePuy)   | Average Paprosky 2b-2c<br>Average AAOS II - III                 |
| Fan <i>et al</i> 2008         | -        | 94.5         | 65 months      | 6.4                   | 3/50                           | 5 Trilogy (Zimmer)<br>3 Duraloc 1,200 series (DePuy)<br>29 Secure-fit (Osteonic) | Average Paprosky 2b-2c  |
| Paxton <i>et al</i> 2011      | 87       | 91           | 53 months      | 14                    | 3/37                           | Non-specified uncemented cup   | 91% AAOS type III<br>9% AAOS type II                            |
| Hansen <i>et al</i> 2006 (23) | 71.7     | 94.1         | 2.8 years      | 17.6§                 | 0/17                           | Interfit (Smith and Nephew)  | 58% AAOS type II<br>42% AAOS type III                           |

\* American Academy of Orthopaedic Surgeons.

† From a total of 564 revisions, 166 were revisions using a jumbo cup.

‡ No report of other patients lost to follow-up than those who died.

§ One patient was re-revised because of dislocations and two showed radiographic migration of the cup.

have been reported with an average follow-up of 2.8 to 13.9 years (Table I).

In our institution we use the Pinnacle® revision cup (DePuy, Johnson and Johnson, Warsaw, USA) for small and moderate acetabular defects. The goal of this study is to report the survival rate of this revision cup in the short term follow-up, which we expected to be in the same range as other techniques.

## MATERIAL AND METHODS

### Patients

In our institution, 119 patients (120 hips) were operated for revision of the acetabular component of a THA using the Pinnacle® revision cup between January 2007 and March 2010. Three patients died before the time of data collection. Two of these patients died before they had a follow-up of at least two years and were excluded from this study; they had no problems with their THA prior to their death and they died from unrelated causes. All grades of acetabular defects and reasons for revision (including infection) were included.

### Acetabular implant

The Pinnacle® revision cup is available in a range of sizes from 38 to 80 mm. It is a 180° hemispherical cup with a porous coated shell made of titanium alloy. The Porocoat® consists of sintered titanium beads in a multi-layered construct. The coating features a larger surface which enhances immediate stability and bony ingrowth. The specific feature of this cup is the possibility to place screws from the rim and the dome of the cup and not just from the dome as in other revision cups (Figs. 1 & 2). These screws can cross each other. Another advantage of using screws from the rim is that these screws can be placed while the cup introducer is still attached to the cup, maintaining its press fit position.

### Surgical procedure

All surgeries were performed by the senior author (MM), using an anterolateral approach to the hip joint with the patient in supine position. The cup to be revised was approached for good visualization *in situ* and then removed, preserving as much bone stock as possible. Different techniques of removal were applied depending

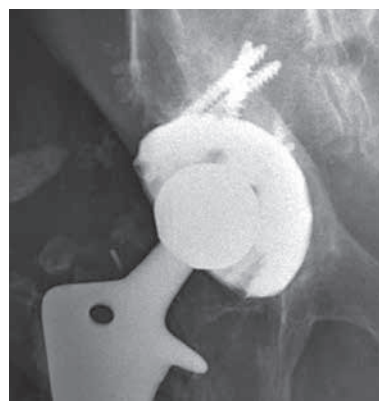


**Fig. 1.** — The PINNACLE® revision cup used in this study, showing rim screws and a dome screw.

on the type of the cup and its fixation, including the use of bone cutting devices such as the “Explant” system (Zimmer, Warsaw, USA). The acetabulum was reamed until enough bone was exposed to allow good support of the new cup (preferably > 50% bone contact). The cementless revision cup was impacted until a press fit stable position was obtained. One or more screws at the rim were added. After disconnection of the cup introducer, screws from the dome of the cup into the ileum were placed as deemed necessary.

In cases with septic loosening, the revision operation was performed after resection arthroplasty and placement of a cement spacer. Antibiotics were administered until infectious parameters were within the normal range and cultures showed a definite negative result.

In an effort to get a maximum of bone fixation and to fill the acetabular defects we use a special technique which consists of pushing small morselized allogeneous



**Fig. 2.** — Postoperative radiograph after revision of a loose cup with a PINNACLE® revision cup.

bone grafts through the screw holes of the dome before screws were added.

### Evaluation

Preoperative radiographs were evaluated to determine the Paprosky score (18) and the American Academy of Orthopaedic Surgeons (AAOS) score (4) to classify the acetabular defects. The most recent postoperative radiograph of each patient was evaluated for signs of loosening and migration which could indicate failure of the cup. At the end of the follow-up in March 2012 the electronic patient record files were reviewed and information about baseline characteristics (sex, age at time of primary THA, age at revision of the acetabular component of the THA) was retrieved. Prospective documented patient information regarding postoperative complications and adverse effects were also collected.

All included patients received a letter which contained an informed consent to be signed and the study protocol. They were asked to complete a questionnaire which included a clinical evaluation using a 100-point Visual Analog Scale (VAS) for pain (6), a modified Harris Hip Score (mHHS) (a self-administered functional and pain score (without the physical examination part which is included in the original Harris Hip Score) with a range of 0-91 points which we converted to a percentage score of 0-100%) (3,21,27) and a Hip disability and Osteoarthritis Outcome Score (HOOS) (14) at the time of data collection. Patients who did not return the questionnaire all agreed to participate in a telephone survey. Patients were also asked about postoperative complications, adverse effects, if they were satisfied with the result or not, and if

they received treatment concerning their hip in another hospital.

### Ethical board approval

Approval was received from the Ethical Committee of the University Hospitals Leuven (approval number B322201214888). The data collection and patient contacts were handled according to the ethical standards in the 1964 Declaration of Helsinki.

## RESULTS

A total of 117 patients (118 hips) were available for evaluation with a clinical follow-up of at least two years (mean : 3.8 years). The mean age was 67 years (SD 11.1). Fifty-eight of the 117 patients were male and 59 were female. In 62 cases (53%) the revision using a Pinnacle® revision cup was not the first revision of the acetabular component.

The indication for revision was aseptic loosening in 65 hips, septic loosening in 42 hips, wear of the liner in 5 hips, recurrent dislocations in 5 hips and in one hip because of a femoral component which failed, requiring simultaneous revision of the acetabular component. The average preoperative AAOS score was between II and III and the average preoperative Paprosky score was between 2b and 2c.

In our series we used 25 constrained and 93 non-constrained liners, depending on the risk of disloca-

tion (decided pre- and/or peroperatively). The median number of rim screws was 2 (range : 0-5), and the median number of dome screws was 1 (range : 0-4).

The median postoperative mHHS was 64 (range : 18-100) and the median HOOS score at last follow-up was 61 (range : 13-100). The average VAS for pain postoperatively was 16 (range : 0-86). Table II shows the outcome scores for the different groups.

In the group of patients who were revised for loosening, two of the 65 needed re-revision (one for loosening and the other for recurrent dislocations, 21 months and 1.5 month postoperative, respectively). In two other patients, the liner was exchanged because of recurrent dislocations ; the fixation and position of the cups were good. In the same group one patient showed significant migration of the cup since the index surgery, consistent with loosening. The patient has not yet been revised because of the limited amount of subjective functional complaints and pain up until now. This amounts to a total of three failures in the aseptic loosening group. Of the 42 patients in the infection group, only one needed re-revision of the cup because of a re-infection (22 month after the index surgery). One patient in the group of recurrent dislocations needed re-revision because of persisting dislocations (29 months after the index surgery). None of the patients operated for wear of the liner needed re-revision surgery or showed any other problems. The total failure rate in the series of 118 acetabular revisions using the

Table II. — Functional outcome following revision for different reasons

|                                 | Median mHHS       | Median HOOS (%)   | Median VAS for pain (points) |
|---------------------------------|-------------------|-------------------|------------------------------|
| Aseptic loosening (65 hips)     | 67 (range 18-91)  | 68 (range 20-100) | 10 (range 0-86)              |
| Septic loosening (42 hips)      | 63 (range 26-91)  | 50 (range 13-100) | 20 (range 0-85)              |
| Recurrent dislocations (5 hips) | 44 (range 30-51)  | 39 (range 31-65)  | 31 (range 12-54)             |
| Wear of the liner (5 hips)      | 82 (range 57-91)  | 77 (range 61-90)  | 30 (range 0-71)              |
| Total (118 hips)                | 64 (range 18-100) | 61 (range 13-100) | 16 (range 0-86)              |

mHHS : modified Harris Hip Score ; HOOS : Hip disability and Osteoarthritis Outcome Score.

Pinnacle® revision cup was 4%, with a mean survival of 18 months of the revised components.

In our case series eight patients (7%) had at least one dislocation of their THA during the follow-up period of two to five years, one of them despite having a constrained liner.

Besides the four re-revised patients, only four other patients were not satisfied with the result on pain and function (3.5%).

## DISCUSSION

Numerous techniques for treating acetabular defects in revision hip arthroplasty have been reported. The use of cementless cups is becoming more common. One of the most important factors for success is good bone quality and sufficient bone stock. It has been suggested that bone-implant contact of more than 50% is an important factor for achieving good results (17). Ingrowth from the native bone is indeed crucial for a non-cemented component.

Besides achieving good contact with the host bone and a good initial fixation in combination with the crossed screws, a special technique which consists of pushing small morselized bone grafts under pressure through the screw holes of the dome has been used in most of our patients. The rationale of this technique is to fill the open spaces behind the cup with bone grafts, creating more bone support for the cup. Subjectively we found that, in the cases of re-revision, the cup was fixed to bone at the places where this technique was used (mostly over the centre of the acetabulum).

The overall failure rate of 4% is, as we expected, comparable with the results of other acetabular components after this period of follow-up (22).

Dislocation is the most frequent complication when performing acetabular revision surgery. Whaley *et al* reported a dislocation rate of 12.3% in patients who were treated with a jumbo cup (29). Dearborn and Harris (5) even showed a dislocation rate of 21%. In our case series eight patients (7%) had at least one dislocation of their THA during the follow-up period of two to five years. We are aware of the fact that the follow-up in this study is not as long as in the referred studies, but we note that in most cases, dislocation of the THA occurs in the

first months (20). Of course, the number of dislocations may also increase again due to wear of the acetabular liner in a later stage. As noted before, we used a constrained liner in 25 patients (21%) having a high risk of dislocation. The use of constrained liners reduces the risk of dislocation but raises the risk of material failure, of acetabular cup loosening and backside wear, because the forces working on the cup are much higher than in a non constrained cup (15). However we did not see any problems with the constrained cups in our patients, except in one patient who dislocated although having a constrained cup. The much lower dislocation rates reported in this study compared to other techniques of acetabular revision surgery indicate that there is a good initial position and fixation of the Pinnacle® revision cup.

Results of revision THAs are more difficult to evaluate than those of primary THAs, because of the heterogeneity of patients, reasons for revision, underlying defects of the acetabulum which may vary and simply because revision procedures are more rare. Although we show lower scores using the mHHS than other studies, we believe that the clinical outcome after revision using the Pinnacle® revision cup is good, with a satisfaction rate of 97% of the non re-revised patients. The low score using the VAS for pain (mean of 25 points) is also positive.

This study shows that a Pinnacle® revision cup is a safe and reliable option for the treatment of small and moderate acetabular defects.

We accept that our patient population is heterogeneous. However, this is inherent to revision surgery of the hip. In the future, when the experience with this acetabular component has expanded, a study with a more homogeneous group of patients may provide better insight in the survival and function of this acetabular revision component.

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