

Medium-term results after the implantation of coated RM cups (12-year results)

From the Orthopaedic Clinic Hessisch Litenau (Director: Prof. BA Blencke, MD)

Summary

Our clinic has implanted the cementless uncoated polyethylene cup developed by R. Mathys (RM cup) since 1982, and the titanium-coated cup since 1985. We have used these cups in 6974 cases of primary hip arthroplasty and in 862 revisions. This study is based on 307 implantations in 1990 (the mean age of the patients was 67.3 years [29-88 years]). Twelve years later, 11 patients required a revision of the cup. The survival rate was 96.4%. The implantation of coated RM cups has provided good medium and long-term results and has exhibited a durable fixation after a minimum follow-up of 12 years.

Keywords: hip replacement – titanium-coated RM cup – cementless Zweymüller stem – straight stem – long-term results

Introduction

The development of prostheses that were based on the isoelasticity of the prosthetic materials and the bone began in 1970. In 1973, *Morscher* and *Mathys* developed a polyacetal hip cup for the cementless implantation.

Later on this cup was made of polyethylene and showed very good early results.

In 1990, however, *Wilson*, *McDonald*, *Morscher*, *Masar* and others reported that the long-term results of the uncoated polyethylene cups were unsatisfactory. This referred not only to the RM cup, but also to the unsatisfactory medium and long-term results of other uncoated polyethylene cups, e.g. the cup constructions of *Ring*, *Freeman*, *Endler*, etc.

Hence, *Mathys* started to introduce polyethylene cups coated with Ceros or titanium, without changing the essential design characteristics of the cup (Fig. 1).

We started to implant cementless cups in 1982 and used at first the uncoated RM cup. In the mid-eighties, we started implanting the Ceros- and titanium-coated RM cups. Since 1985, titanium-coated RM cups are the standard implant used in our clinic. From 1982 to 2002, we implanted a total of 7816 RM cups (Table I). In middle-aged to old patients, the coated RM cups provide good results and a durable fixation for up to 12 years. We implanted the RM cup in primary interventions as well as in 852 cases of revision.

We selected the RM cup, because it can be implanted without cement even in difficult anatomical situations and allows exact positioning in cranial anchoring with a minimum of bone loss (Table II). Another reason for using this type of cup was the variable anchoring that can be adapted to the anatomical situation, e.g. hip dysplasia (Fig. 2 & 3) or other defects such as acetabular roof cysts. We also believe that the high elasticity is more favourable than the rigid implants (e.g. metal cups with screws or press-fit cups with PE, metal or ceramic inlays).

Table I: 1982-2002 implantations of RM cups

-
- 8177 primary THP
= 6864 RM cups (85.17%)
 - 1224 complete THP revision
or isolated cup revision
= 852 RM cups (69.61%)
-

We observed only very few early postoperative complications after the implantation of the uncemented cups when comparing them to the cemented cups used before. This was probably due to the orientation of the in-

clination and anteversion of the cup that can be planned and executed with precision. Very few dislocations occurred. Early dislocations or pullouts of the cups were very rare. Our clinical experience showed the same service life for coated RM cups that the literature indicates for cementless so-called press-fit cups. The RM cup is a high-quality and economic implant. We took the year 1990 to establish the medium to long-term results of titanium-coated RM cups.

Fig. 1: RM cup and implantation diagram

Fig. 2: 33-year-old G. M., 3 and 6 years postoperatively

Table II: reasons for using the RM cup

1. Exact positioning using an easy instrumentation
2. Cranial anchoring principle
3. Variable anchoring possibilities
4. Minimal bone loss during implantation
5. Relatively high elasticity
6. Few early complications, low dislocation rate
7. Long lifetime
8. Economic implant

Material and method

Mathys Ltd Bettlach, Switzerland produces the cementless RM cups we use. They are spherical polyethylene cups with a pure titanium powder coating.

Fig. 3: 59-year old W. A., 2 and 7 years postoperatively

Table III: prosthetic hip head implantations at the OK Hess. Lichtenau in 1990

§ 307 primary THP with RM cup
§ 3 primary THP without RM cup
§ 36 revisions with RM cup
§ 23 revisions without RM cup
§ 13 head endoprotheses
378 THP implantations

Table IV: age distribution for the THP implantations in 1990

§ n. 307 THP implantations (RM cup)
- 3 bilateral THP
§ 203 women mean age 68.30 years
§ 101 men mean age 63.53 years
304 patients mean age 67.3 years (29-88 years)

Table V: 86 deaths in 1990-2003 (f. 60, m. 26)

The cup gets clamped in the acetabulum by the slightly oversized cup compared with the acetabular reamer used last, by the offset of the two pegs on the cup compared with the drilling direction of the aiming device and by three screws inserted peripherally. In case of cysts or poor bone substance, several screws can be introduced in various positions. Hence, it is nearly always possible to achieve an absolutely stable primary fixation.

Patients

The present study includes all the patients who have received a primary total hip prosthesis and a titanium-coated RM cup between the first of January and 31st of December 1990. The year 1990 was selected, because in this year we used only titanium-coated cups. For demographic reasons, we also hoped that the number of deceased patients would not be too high at the recording time of the results 12 years later. In 1990, the orthopaedic clinic Hessisch Lichtenau used RM cups in 307 primary hip transplantsations. For various reasons, we selected a cemented cup version in 3 cases only. We also performed 59 revisions, al-

most all of them using the RM cup. In addition, we implanted 13 prosthetic hip heads for the treatment of fractures in very old patients of over 80 years of age (Table III).

The 307 primary total hip prostheses with the RM cup were implanted in 304 patients (3 times bilaterally). The case material consisted of 203 women with a mean age of 68.3 years and of 101 men with a mean age of 64.5 years. The age distribution ran from 29 to 88 years (Table IV).

Table VI: primary THP in 1990

- § 181 patients were questioned in 2002
- § 6 patients were not satisfied
 - 1 known stem loosening (cup NAD)
 - 2 known cup loosening (stem NAD)
 - 1 slight pain
 - 2 generally dissatisfied

Table VII: follow-up after THP with hybrid prosthesis in 1990

- § 224 straight stem prostheses type Müller and RM cup (1 bilateral THP in 1990)
 - 158 women mean age 72.40 years (55-88 years)
 - 68 men mean age 70.28 years (41-81 years)
- § 119 patients with 120 THP implantations were questioned
- § 16 patients could not be reached
- § 81 patients were deceased
- § 11 implant revisions
 - 1 stem revision, 3 revisions of the cup only
 - 6 complete revisions (2-12 years postoperatively)
 - 1 explantation (re-implantation after 6 months)
- § 2 early infections

Table VIII: follow-up after THP using a cementless prosthesis in 1990

- § 83 THP using the Zweymüller stem and the RM cup (2 bilateral THP in 1990)
 - 46 women mean age 55.67 years (34-83 years)
 - 35 men mean age 52.74 years (29-64 years)
- § Follow-up of 72 patients
- § 5 patients were deceased
- § 2 patients could not be reached
- § 2 implant revisions
 - (1 stem revision 11 years postoperatively,
1 stem revision 7 years postoperatively after an infected inguinal herniotomy)

The implantation of a hybrid endoprosthesis was based on the principle of an age of more than 65 years. This principle was sometimes not observed, for instance when the patient asked for a cemented cup or in tumour patients, etc. As a rule, less than 65-year-old patients received a completely cementless total hip prosthesis. But exceptions occurred also here. We use a cementless Zweymüller stem prosthesis in all patients suffering from pertrochanteric fractures and in those whose fracture of the coxal femoral end was treated by internal fixation.

According to these criteria, we implanted 224 straight stem prostheses and an RM cup in 158 women (mean age 72.4 years, 55-88 years) and in 66 men (mean age 70.3 years, 41-81 years).

Eighty-one patients were treated with 83 cementless Zweymüller stem prostheses and a titanium-coated RM cup. The case material consisted of 46 women (mean age 55.7 years, 34-83 years) and 35 men (mean age 52.7 years, 29-64 years).

The mean age between the two collectives differed strongly due to the surgical criteria mentioned above. The difference was 17.4 years.

In 2002, 12 years after the implantation, we examined the course of all 304 patients with 307 total hip prostheses, who underwent surgery in 1990. Eighty-six patients were deceased, 60 women and 26 men (Table V). Two patients were excluded from the study due to a surgically revised early infection. Eleven cases had required a cup revision within the 12 years (see below). Despite numerous efforts, we were unable to reach 18 patients. We questioned the patients by phone or directly with the help of a catalogue containing only a few questions. We directly questioned those patients who, in 2002, had been in our clinic for an ambulatory or in-patient treatment of a hip disease or any other disease. 175 of the 181 patients questioned said that they were satisfied with their operated hip or had only minor hip troubles, which impaired their daily activities

only slightly. In one case, a stem loosening (straight stem) was responsible for the trouble while the RM cup was uneventful, and in two cases a cup loosening with an uneventful prosthetic stem. One patient complained of slight to medium-severe pain. Two patients did not provide any further information. They were generally unhappy with the result of the total hip-prosthesis implantation (Table VI).

As expected, the follow-up showed differences in the patients who had been treated with cementless prostheses or with hybrid prostheses. The patient collective with hybrid prostheses (RM cup and a cemented straight stem prosthesis) had a very high mean age of 71.9 years, which resulted also in a high death rate (81 of 224 patients). Fewer patients could be reached because they were either deceased or had changed their place of residence (Table VII). In contrast, only a few of the patients treated with completely cementless prosthetic systems (RM cup and Zweymüller stem) (mean age 54.5 years) were deceased (5 patients, 2-11 years postoperatively). Only 2 of 83 patients could not be reached (Table VIII).

The low number of dissatisfied patients does not permit to make any statement about possible implant-related differences.

Between 1990 and 2002, we had to revise the implant of 13 patients: 3 isolated cup revisions, 3 isolated stem revisions, and 6 complete prosthetic revisions. In one case, we explanted the prosthesis because of a suspected infection and re-implanted it after 6 months. No germs were established at that time. The implant revision occurred more often in the group treated with hybrid prostheses. Eleven of 224 patients required a cup revision within 12 years. The mean lifetime up to the revision was 9.6 years. All prosthetic cup revisions performed in our clinic were caused by aseptic indications, but we did not find any germs. The case report of two complete prosthetic revisions performed outside of our clinic did not mention any indications of inflammation. The most striking thing is that 2 of 11 cup revisions took place within the first two years after the intervention. We suspect that despite the absence of germs, the loosening might have been caused by a low-grade infection. The other loosening occurred between the 7th and the 10th year after the implantation. These loosening were clearly caused by wear.

Two prosthetic stem revisions were required in the collective treated with completely cementless prostheses. An aseptic loosening occurred in one case.

Our questioning of patients, the results of the follow-ups and the revisions performed show a survival rate of the RM cup of 96.4% after an implantation time of 12 years (Fig. 4).

Fig. 4: survival time in years

Table IX: polyethylene cups (uncoated)

Bertin and others	ORTH. T. Surg.	1990	1878	0.5-6 years positive
Träger and others	Surgeon	1985	391	3-4 years positive
Racalbuto and others	Lecture	1987	150	3-7 years valuable
Wilson and others	JBJS	1990	545	5-10 years negative
Krismer and others	Acta Orthop. Traum.	1991	160	7-8 years negative

Discussion

The development of cementless total hip prostheses was not spared by failures. Materials tested in vitro or by simulators often turned out to be useless in praxi. Anchoring mechanisms such as certain threaded rings (*Weil* and others) showed early loosening. The RM cup designed as an elastic implant, was first made of various materials. Polyacetal turned out to be a tribologically unsuitable material. The very good early results of the polyethylene cups were confronted with bad medium-term ones (*Bertin et al*, *Träger* and others, *Racalbuto* and others, *Wilson* et al, and *Krismer* et al.) (Table IX). Also other polyethylene cups with a direct polyethylene-bone contact showed similar high failure rates (*Ender*, *Freeman* and others). Hence, our implantations using uncoated RM cups between 1982 and 1987 were accordingly unsatisfactory. The implant fell into disrepute and we started to use threaded and press-fit cups from various producers. We immediately started to reuse the RM cup when the literature reported satisfactory results with RM cups coated with Ceros or titanium, and we use it as standard implant for primary and revision interventions. The results presented here show that the titanium-coated RM implant provide good to excellent medium to long-term results. The surgical success can be compared to the results of other cementless prosthetic cup models.

Various studies show 10- to 12-year results with a survival rate of 95% and more. The results of the RM cup are in the same range (Table X).

We have to state, however, that our study is a retrospective one that is not based mainly on follow-up results. Extensive investigations allowed us to get sufficient information to a considerable extent about the fate of the patients.

The analysis of the failed cases of the RM cup showed that the primary cause for the aseptic loosening of the cup was not the separation of the cup's surface from the pelvic bone. It was established that the spherical

metal heads caused a clearly higher wear of the PE cup. These PE wear particles led to an osteolysis in the acetabulum and a secondary loosening, which in some cases also caused a fracture of the cranial edge of the RM cup. Our study of the Zweymüller collective clearly shows the tribologically improved situation when using a polyethylene-ceramic pairing. The long-term results were better than those of the straight stem collective, despite the essentially higher load-bearing situation in younger patients (on the average 17.4 years younger). At that time, we usually selected a PE-metal pairing for patients over 75 years of age. Our follow-up lets us draw the conclusion that the implantation of cementless prosthetic cups are successful even in old patients. Our study did not provide an age-related failure rate. Even though the present study imparts the 12-year results using the RM cup and is based on a inhomogeneous case material of age groups, we believe to be entitled to say that the cementless RM cup with titanium coating is a suitable implant in difficult anatomical situations even at a ripe old age.

Literature from the author on request

Authors address:
Prof. BA Blencke, MD
Orthopaedic Clinic Hessisch Lichtenau
Am Mühlberg
C-37235 Hessisch Lichtenau
Germany