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ORIGINAL ARTICLE

Retrospective Cohort Study

Mid-term clinical outcomes of the uncemented Robert Mathys pressfit cup

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Abstract

BACKGROUND

The use of uncemented cups during total hip arthroplasty (THA) has gained popularity in recent years. The Robert Mathys (RM) pressfit cup, an uncemented monoblock implant is expected to preserve bone density due to its composition and external surface, while reducing backside wear with its monoblock construction. These factors should lead to a high survival rate of the implant.

AIM

To evaluate the mid-term survival and functional outcome of the RM Pressfit cup in a large study population.

METHODS

Between 2011 and 2020, we included 1324 patients receiving a primary THA using the RM pressfit cup. Final clinical follow-up was performed at 2 years postoperatively with the Dutch arthroplasty register used to assess implant status thereafter. Revision for acetabular failure and reason for revision were reported to evaluate implant survival, while the hip disability and osteoarthritis outcome score (HOOS) scores were used to assess functional outcome.

RESULTS

The mean age at surgery was 64.9 years. The mean follow-up was 4.6 years. Of the

1324 THAs performed, 13 needed cup revisions within 5 years after index THA: 5 due to aseptic loosening, 6 due to infection, 2 due to dislocation and 2 due to other causes. This resulted in a 5-year cup survival of 98.8% (95%CI: 98.1-99.5). Nine of the cup revisions occurred within the first year after index THA. HOOS scores increased significantly in all domains during the first year and levelled out during the second year.

CONCLUSION

In the present study, the RM pressfit cup demonstrated excellent clinical outcomes at mid-term follow-up; however, future studies are needed to assess the long-term outcomes of this acetabular implant.

Key Words: Total hip arthroplasty; Uncemented RM pressfit cup; Hip osteoarthritis; Cup revision; Pressfit; Aseptic loosening

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Core Tip: In this retrospective study we aimed to evaluate the cup revision rate and patient reported outcome measures in patients implanted with the uncemented Robert Mathys Pressfit cup. We found that this particular acetabular implant retained a high survival rate for cup revision and provided patients with adequate satisfaction in patients with a mid-term follow up.

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INTRODUCTION

According to the Dutch arthroplasty register (LROI), approximately 30000 total hip arthroplasties (THA) have been performed yearly in the Netherlands in the last decade[1]. Both the acetabular and femoral components have cemented and uncemented implant versions. Although the results of uncemented and cemented acetabular cups are comparable, the majority of the acetabular cups used during THA in the Netherlands is uncemented[1-4]. Despite excellent outcomes, the optimal choice of type of uncemented acetabular implant remains challenging. One of the challenges is the modularity of the cup. In the case of revision surgery, a modular cup has the advantage of targeted replacement of only the damaged component. However, the absence of space between the liner and the shell of the cup in a monoblock implant prevents micromotion which in turn prevents backside wear[5]. Another challenge is the change in surrounding bone density as a result from the material of the acetabulum implant. Cementless pressfit acetabular cups with a metal shell have been reported to cause a decrease in periacetabular bone density due to the structural stiffness of the metal shell[6,7]. This poses a significant concern in revision surgeries considering THA implants have an average lifespan of 25 years and are being offered to younger patients, while lower age at index hip arthroplasty is associated with a higher lifetime risk of revision[1,8,9]. Reliable fixation of the revision implant can therefore be impeded, as adequate periprosthetic bone quality and quantity is warranted.

The Robert Mathys (RM) pressfit cup, an uncemented monoblock implant, is the successor of the RM classic cup that has a 94% survival rate at 20 years for revision due to aseptic loosening[10]. The difference between these cups lies in their fixation technique with the RM classic cup being fixated with screws or pegs, while the RM pressfit cup needs no such fixation. It achieves its primary stability through the equatorial press-fit and a flattened polar region which guides compressive forces to the periphery of the implant. Abandonment of screw fixation has the added benefit of absence of screw channels through which polyethylene debris might migrate and contribute to aseptic loosening. However, when there are doubts regarding initial intraoperative stability, additional fixation with up to 4 screws is possible.

The main proposed advantage of the RM pressfit cup is bone density preservation through its composition and outer coating[11,12]. The RM Pressfit cup has 2 types of compositions: (1) The ultrahigh-molecular-weight-polyethylene; and (2) highly crosslinked polyethylene with vitamin E (RM Pressfit Vitamys). Both cups are coated by a thin layer of noncorrelating titanium particles with no structural stiffness. These components of the RM pressfit cup are expected to reproduce the biomechanical behavior and load transfer of the acetabulum under physiological conditions, while enhancing osseointegration leading to improvements in secondary stability.

Previous studies have reported favorable outcomes regarding the use of the RM Pressfit cup[13-17]. However, these studies included a low number of patients with a long follow-up period or a larger number of patients with a shorter follow-up period and without functional outcomes. Hence, the aim of this study was to evaluate 5-year implant survival and functional outcomes after primary THA using a RM pressfit cup in a large study population.

MATERIALS AND METHODS

This was a multicentric retrospective cohort study in a collaboration between Xpert Clinics Orthopedie Amsterdam (formerly Medical Center Slotervaart Orthopedie) and VieCuri Medical Centrum. The present study concerns a sub study from a large cohort study. Ethical approval for this study was obtained (NL47055.048.13). Informed consent was obtained from all participating patients prior to inclusion in this study. This study was reported according to the reporting guideline in accordance with the 'Strengthening the Reporting of Observational Studies in Epidemiology' checklist for cohort studies.

Patients were included in case they received a RM pressfit cup or RM pressfit vitamys cup implantation during primary THA and a minimum of 2 years of follow-up. Patients were excluded in case of a body mass index of > 35 kg/m^2, an American Society of Anesthesiologists score > 3 or revision surgery. After screening for inclusion and exclusion criteria, 1324 patients who underwent a THA between 2011 and 2020 were included in this study.

The surgeries were performed by several surgeons using varying approaches (Table 1). The RM Pressfit cup was impacted after the acetabulum was reamed. All hip arthroplasties used an uncemented stem as the femoral component: 135 Twinsys (8.9%), 427 cementless bipolar hemiarthroplasty (28.3%) and 553 Optimys (36.6%), with 374 unknown stems (24.8%). Patients were allowed full weight bearing and were mobilized with 2 elbow crutches on either the day of or the day after surgery. All included patients returned for routine clinical follow-up at 3 months, 6 months, 1 year and 2 years postoperatively. After final clinical follow-up, the LROI registry was accessed to retrieve information regarding implant status. The primary outcome measurement in this study was survival of the implant for cup revision. Cup revision was defined as surgery of an implanted THA during which the acetabular component was repaired, replaced, added, or manipulated. Secondarily, survival of the implant for all revisions (including stem revision) was assessed. Functional outcome was measured using the Hip Disability and Osteoarthritis Outcome Score (HOOS) was used, being reported preoperatively with follow-ups at 3 months, 6 months, 1 year and 2 years postoperatively[18,19].

Statistical analysis

Descriptive statistics were used to report the characteristics of the patient population. Continuous variables were visually assessed for a normal distribution and are presented as the mean ± SD. In the case of a skewed distribution of variables, they are presented as the median and interquartile range (IQR). Categorical variables are presented as frequencies with accompanying percentages. Survival analysis was performed using the Kaplan-Meier method to report the survival rate with the corresponding 95% confidence interval (CI). For the survival analysis, the day of surgery was used as the starting date and date of revision or the latest date of data retrieval from the LROI as the endpoint. Additionally, competing risk analyses were performed with death as competing risk, to calculate cumulative incidences of cup- and all cause revision. A mixed model analysis was performed to report the changes in PROMs 2 years postoperatively with their corresponding 95%CI. The PROMs of the first and second postoperative years were modeled separately to evaluate the difference in changes during both the follow-up periods. Potential confounders were age, gender and BMI (Body Mass Index) and these were corrected for in the mixed model analysis. All tests were 2-sided and a *P* value of 0.05 was used to establish statistical significance. A complete case analysis was conducted with regards to missing data. Statistical analyses were performed using SPSS version 26 (IBM Corporation, Armonk, NY, United States).

RESULTS

The study population consisted of 1324 patients of whom the majority was female (63%), mean age was 64.9 (SD 11.6) years (Table 1).

Survival outcomes

Median follow-up of the patients was 4.4 years (IQR: 2.8–6.4). Eighty-three patients (6.3%) died due to causes unrelated to the THA and had their implant in situ at the time of death. During the 5-year follow-up 13 patients needed cup revision, resulting in a 5-year KM survival rate for cup revision of 98.8% (95%CI: 98.1-99.5) (Figure 1A). Reasons for revision of the cup were: aseptic loosening (n = 4), infection (n = 6), dislocation (n = 2) and other causes (n = 1). The 5-year survival rate including stem revision was 97.1% (95%CI: 96.1-98.1) (Figure 1B). Reasons for revision of the stem (n = 23) were: periprosthetic fracture (n = 5), dislocation (n = 5), femur loosening (n = 8) and other causes (n = 5). Competing risk analysis revealed a cumulative incidence of 1.0% (95%CI: 0.6-1.7) and 2.9 (95%CI: 1.9-3.7) for cup- and all cause revision, respectively.

The median time from index THA to cup revision in the 5-year follow up period was 0.3 years ranging from 0.2 years to 2.3 years. Nine acetabulum revisions (69%) were performed within the first year after index arthroplasty.

PROMs

HOOS scores were available for 804 patients (60.7%) preoperatively and 406 patients (30.6%) 2 years postoperatively. Mean HOOS scores increased significantly from baseline to 2 years postoperatively for all domains (Table 2). The scores increased from 42.6 (SD: 18.5) to 84.5 (SD: 17.6) for symptoms, 42.0 (SD: 16.5) to 88.2 for pain (SD: 17.3), 43.3 (SD: 17.5) to 87.3 (SD: 17.5), for activities in daily living 23.9 (SD: 19.0) to 74.1 (SD: 26.2) for sports and recreation and 25.7 (SD: 15.6) to 78.4 (22.4) for quality of life. During the first year, the HOOS scores increased significantly and started to level out with the second year reporting significant changes only in the domains of symptoms and quality of life (Tables 2 and 3, Figure 2).

Table 1 Baseline demographic and clinical characteristics of the study population, *n* (%)

	***N* = 1324 THA's**
Demographic characteristics	
Age at surgery, yr, mean (SD)	64.9 ± 11.6
Female gender	835 (63.1)
Right side	724 (54.7)
BMI, kg/m^2, mean (SD)	26.4 ± 4.1
Clinical characteristics	
Diagnoses	
Osteoarthritis	948 (71.6)
Dysplasia	55 (4.2)
Fracture	28 (2.1)
Osteonecrosis	37 (2.8)
Rheumatoid arthritis	21 (1.6)
Posttraumatic	26 (2.0)
Other	19 (1.4)
Surgical approaches	
Anterior	254 (19.2)
Anterolateral	219 (16.5)
Posterolateral	50 (3.8)
Straight lateral	613 (46.3)
Unknown	188 (14.2)

BMI: Body mass index; THA: Total hip arthroplasty.

Table 2 Yearly change of the PROMs (ß) during the first postoperative year

HOOS	**First year**			
	ß$_{crude}$ (95%CI)[1]	***P* value**	**ß$_{adjusted}$ (95%CI)[1]**	***P* value**
Symptoms	40.3 (29.6-51.0)	< 0.001	39.6 (27.2-52.0)	< 0.001
Pain	41.9 (39.8-43.9)	< 0.001	40.7 (38.6-42.9)	< 0.001
ADL	39.9 (37.9-41.9)	< 0.001	38.9 (36.8-41.0)	< 0.001
Sport/Rec	46.7 (44.2-49.2)	< 0.001	45.5 (42.9-48.2)	< 0.001
QoL	45.9 (43.6-48.2)	< 0.001	45.2 (42.8-47.6)	< 0.001

[1]Mixed model analysis, ß = yearly change (crude and adjusted for age, gender and BMI). HOOS: Hip disability and osteoarthritis outcome score; ADL: Activities in daily living; Sport/Rec: Sport and recreation; QoL: Quality of life.

DISCUSSION

Our study aimed to evaluate the mid-term survival of the RM pressfit cup in 1324 patients and found a survival rate of the acetabular cup of 98.8% at 5 years. The 5-year survival rate of the total hip arthroplasty was 97.1%. A significant increase in HOOS scores was observed in the first year ranging from 39.9 to 46.6 across all domains. No significant changes were observed during the second year.

In our study, the RM pressfit cup achieved excellent primary stability with none of the patients requiring additional screw fixation. Erivan *et al*[13] reported a complementary screw fixation rate of 4.6% in a population of 189 patients. However, recent studies have shown that cup stability is not influenced by additional screw fixation and does not improve clinical outcomes[20,21]. Adequate stability can be achieved without screws, and these are not a requirement for

Table 3 Yearly change of the PROMs (ß) during the second postoperative year

HOOS	Second year			
	$ß_{crude}$ (95%CI)[1]	*P* value	$ß_{adjusted}$ (95%CI)[1]	*P* value
Symptoms	0.95 (-0.40-1.30)	0.169	1.63 (0.20-3.05)	0.025
Pain	0.04 (-1.22-1.31)	0.948	0.44 (-0.93-1.80)	0.529
ADL	0.39 (-1.06-1.83)	0.597	0.81 (-0.70-2.32)	0.294
Sport/Rec	-0.03 (-2.19-2.13)	0.977	0.98 (-1.34-3.29)	0.407
QoL	2.20 (0.32-4.09)	0.022	2.41 (0.40-4.41)	0.019

[1]Mixed model analysis, ß = yearly change (crude and adjusted for age, gender and BMI). HOOS: Hip disability and osteoarthritis outcome score; ADL: Activities in daily living; Sport/Rec: Sport and recreation; QoL: Quality of life.

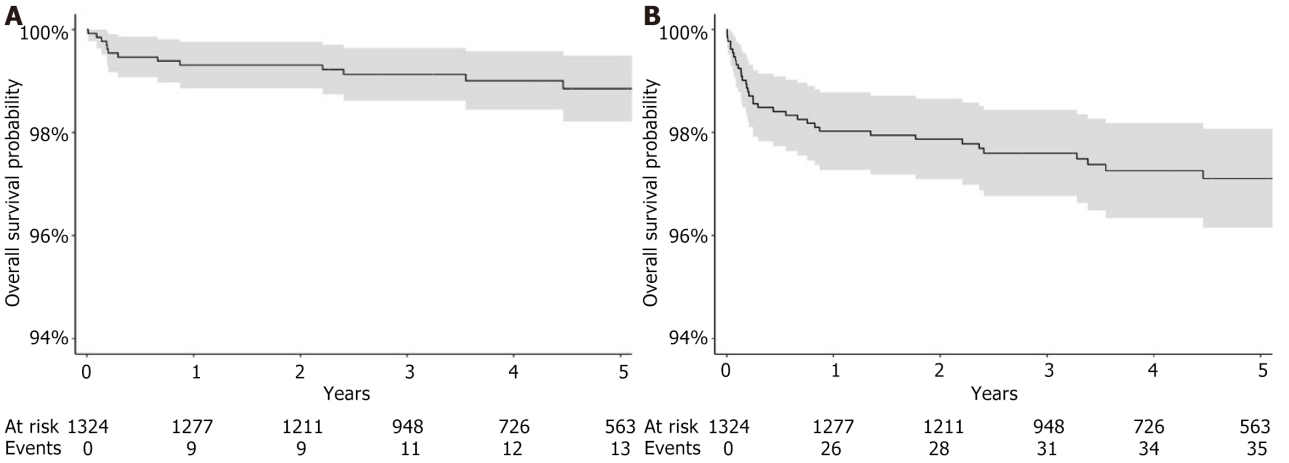

Figure 1 Kaplan-Meier curve visualizing the 5-year survival of the Robert Mathys pressfit cup. A: Revision for acetabular failure with the numbers at risk each year; B: All-cause revision, with the numbers at risk each year.

cementless press-fit acetabular cups[22].

Our study found a 1.2% 5-year cup revision rate which is similar to other uncemented cups currently used in THA[23-25]. Previous studies concerning the RM pressfit cup reported zero revisions for acetabular failure in a population ranging from 50-615 cases[13,15,17]. Hooper *et al*[17] likewise reported no revisions for acetabular failure at 5 years, however, 22% of hips (93) had an increased risk of late failure based on early cup movement before stabilization. The patients in these studies were all significantly older than the patients in our study (72-76 years *vs* 64.9 years). This might explain the higher revision rate found in our study as younger patients receiving a THA have a higher risk of early implant failure[26,27]. This is also shown by the results as 9 of the 13 cup revisions occurred within the first postoperative year. This is confirmed by a study of Lafon *et al*[14] which included patients with a similar age and reported a 4-year revision rate of 3.3%.

Aseptic loosening is one of the most common causes of revision after THA and our study showed a 0.3% revision rate for aseptic loosening at 5 years[28]. A study by Rochcongar *et al*[29] found decreased wear rates over the first 3 years after index THA with the pressfit vitamys which should lead to the prevention of aseptic loosening in the long-term. In our study, we pooled the RM pressfit cup and RM pressfit vitamys together and did not study the clinical outcome of these two implants separately as the difference in effect between these two cups is expected to be measurable only in the long-term. However, to assess these effects, future studies evaluating long-term outcomes of both the RM pressfit cup and RM pressfit vitamys are needed for confirmation.

Regarding the functional outcome, we found mean HOOS scores ranging from 78.4 to 87.3 across all domains. Erivan *et al*[13] reported a mean HOOS score of 75.9 in their study; however, the lower score may be explained by the much higher average age of their study population which would influence general health regardless of THA. The minimally clinically import change of the HOOS scores calculated using an anchor-based method range from 13 to 36 across the different domains[30]. In the first postoperative year, the changes in HOOS scores across all domains were above the highest value in the range, while between the changes in HOOS scores of all domains during the second postoperative year were below the lowest value in the range and thus not clinically relevant.

Limitations

Use of the LROI is seen as a minor limitation as standard questions are applied for data collection in the LROI and

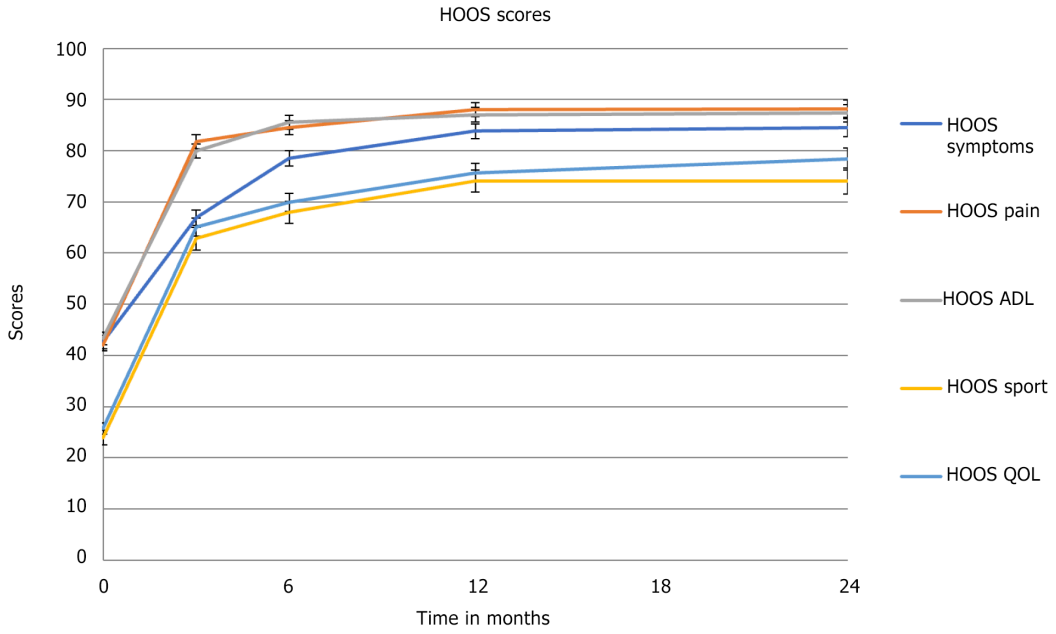

Figure 2 Line graph illustrating the changes in hip disability and osteoarthritis outcome score per domain at each follow-up (with 95%CI).
ADL: Activities in daily living; HOOS: Hip disability and osteoarthritis outcome score.

therefore it is not possible to precisely know the reason for revision. Another shortcoming in this study is the number of patients we have information on, regarding the functional outcome compared to the whole study population. Additionally, there was a significant loss to follow up regarding the functional outcome seen in the number of patients available at the 2-year follow-up. Patients benefitting from the surgery could be less likely to fill out the questionnaires at follow-up, creating bias in the results.

CONCLUSION

The RM pressfit cup shows excellent clinical outcomes at mid-term follow-up with good patient satisfaction in a large population; however, future studies are needed to assess the long-term outcomes of this acetabular implant.

FOOTNOTES

Author contributions: Ramsodit KR, Sierevelt IN, Janssen ERC, Kaarsemaker S, Haverkamp D have made substantial contributions to conception and design, acquisition of data, analysis and interpretation of data, and have been involved in drafting the manuscript; Ramsodit KR and Sierevelt IN have been involved in the acquisition of data; all authors have been involved in revising the manuscript, critically for important intellectual content, and have given final approval of the version to be published.

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Informed consent statement: All patients provided informed consent prior to participation in the study.

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