

Dual-mobility cup in total hip arthroplasty in patients less than fifty five years and over ten years of follow-up

A prospective and comparative series

Jean-Marc Puch¹ · Guy Derhi² · Loys Descamps¹ · Régis Verdier³ · Jacques H. Caton⁴

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Abstract

Purpose We report clinical and radiological outcome of a dual mobility cup (DMC) of 2nd generation after a minimum of ten year-follow-up (FU). The goal of this work was to compare the results of this DMC in patients aged less than 55 years and in patients aged more than 55 years.

Methods From 2000 to 2005, a prospective and consecutive series of 119 THAs with a cementless DMC of 2nd generation (GIROS) were performed in patients aged less than 55 years and 444 in patients aged more than 55 years.

Results The mean FU was 11 years (8 to 15 years). Survivorships (failure of both components or cup loosening) were not different between patients aged less than 55 years and patients aged more than 55 years. There was no dislocation. DEVANE classification, Harris, PMA and Oxford scores

improved after THA but no difference could be found between < 55 years and > 55 years patients.

Conclusion These results are better than those of first generation (BOUSQUET) DMC (77 % of survival rate at 20 years of FU). These results are in the same agreement than those of the literature: 99 % of survival rate at 14.2 years of FU for KERBOULL with a low friction arthroplasty and 96.5 % at ten years of FU for ceramic/ceramic bearing (R CHANA).

The DMC for young patient is a relevant surgical option with no dislocation and excellent clinical results and survival rate at more than ten years of FU.

Keywords Dislocation · Dual mobility cup · Less than 55 years · Long term results · Total hip arthroplasty

✉ Régis Verdier
r.verdier@groupe-lepine.com

Jean-Marc Puch
jmpuch@me.com

Guy Derhi
guy.derhi@free.fr

Loys Descamps
loysd@free.fr

Jacques H. Caton
caton.jacques@wanadoo.fr

¹ Clinique Saint-Georges, 2 Avenue de Rimiez, 06100 Nice, France

² Pôle Santé Saint-Jean, 53 avenue des alpes, 06800 Cagnes-sur-Mer, France

³ 175 rue Jacquard – CS 50307, 69727 Genay Cedex, France

⁴ Clinique orthopédique 103 rue Coste 69300, Caluire, France

Introduction

Total hip arthroplasties (THA) in patients aged 55 years and younger implies numerous years of intense activities and sports and are very challenging with regard to osteolysis, wear and stability.

Dislocations may occur throughout patient's and implant's lives and were termed "cumulative risk" by Caton [1] and Berry [2] in 2004, entailing an increasing rate of 1.39 and 1 % every five years respectively. Dislocations also became the prime reason for revisions within the first three months after primary THA in the American Joint Replacement Registry (AJRR) [3]: 17.4 % before infections and periprosthetic fractures.

To reduce the dislocation risk, large ceramic heads wider than 32 mm diameter (36 mm is the most often used diameter) are increasingly used in routine THA. However there are limitations associated with this concept, mainly fretting corrosion of the neck taper with the risk of "trunnionosis" and in the case of ceramic on ceramic bearing noise with squeaking.

The dual mobility cup (DMC), a French innovation developed in the early 1970s (1974–1976) by Bousquet and Rambert [4–6], represents an alternative to large femoral heads without the adverse effect of too large heads.

Confident with this implant, since 2000 we have performed THAs with a dual mobility liner for all patients, whatever their age.

The goal of this research work was to compare the results of this implant with over 10 years of follow-up (FU) in patients aged less than 55 years and in patients aged more than 55 years through continuous and prospective series.

Material and method

From 10/2000 to 12/2005, at two orthopaedic centres by three senior surgeons:

- One hundred nineteen THAs were performed, in 105 patients aged less than 55 years with a cementless 2nd generation DMC (GYROS, Fig. 1a). The femoral implant was a tri-tapered cementless titanium alloy stem fully hydroxyapatite (HA) coated with a collar in 97.8 % of cases: 67 (56.3 %) CORAIL (Depuy); 49 (41.2 %) TARGOS (Groupe Lepine, Genay, France), and in three cases (2.2 %) we used different cementless modularity stems: VISO (Serf) in one case and a cementless custom-made stem, EGOFORM, for two hips in the same patient. It is cohort 1.
- During the same period 1064 identical THAs (same DMC and cementless stems) were performed in patients aged more than 55 years. The first patients of this series operated from 10/2000 to 12/2002 were reviewed corresponding to 444 THA in 429 patients. Cementless stems consisted mainly of CORAIL stems (Depuy) in 86.7 % of THAs and TARGOS stems (Groupe Lepine, Genay, France) in 9.21 % of THAs. Eleven VISO femoral stems,

one KAR, three BHS, one AURA and only one cemented femoral stem (Titan) were also used. It is cohort 2.

The femoral stems had a polished and rounded neck with a 12/14 Morse taper.

The GYROS cup (a second generation DM) (Fig. 1b) was developed by DePuy, a Johnson & Johnson company. It is a hemispherical stainless steel and grit-blasted cup covered with a monolayer HA, with a thickness of 150 µm, an obturator hook and two superior flanges with optional screw. The liner was a standard polyethylene UHMWPE (PE) sterilized by gamma radiation under vacuum.

All data relating to patient parameters, such as age, gender, BMI, aetiology, and pre and post-operative DEVANE classification as well as Harris hip score (HHS), POSTEL-MERLE D'AUBIGNE (PMA) and OXFORD scores were described and compared. All patients were also systematically reviewed with front and lateral X-rays to assess osteolysis, migration and radiolucent lines according to the zones described by De Lee and Charnley for the pelvic side and Gruen for the femoral side. Assessment of the penetration of the inner articulation was performed by Chevrot-Kerboull method when possible.

Characteristics of patients at index surgery are presented in Table 1. The average age was 49.9 years in cohort 1 and 72.3 years in cohort 2. Mean BMI was similar in both cohorts. Other characteristics were different: there were less women and more hip dysplasia and osteonecrosis in cohort 1 compared to those aged more than 55 years (cohort 2) ($p < 0.01$).

In cohort 1, only eight patients were lost to FU (6.7 %), four patients were dead of unrelated causes (3.3 %). In cohort 2, 36 patients were lost to FU (8.1 %), 179 patients were dead of unrelated causes (40.2 %).

The approach was posterolateral for 72 % of patients and HARDINGE type for 28 % for cohort 1 and posterolateral for 67.1 % and HARDINGE type for 33.9 % for cohort 2.

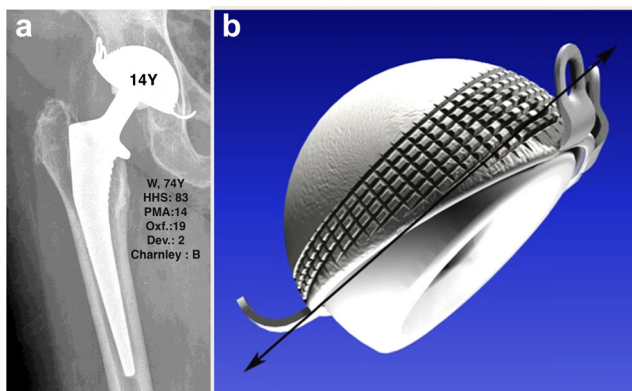


Fig. 1 a Gyros acetabular cup at 14 years of follow-up b Original Gyros DMC with two flanges and one obturator hook (Depuy)

Statistical analysis

Group comparison was performed either by chi-square or FISCHER exact test and *t*-test.

Survival probability (survivorship) was calculated using KAPLAN-MEIER method with 95 % confidence intervals, and endpoints were defined as revision of the acetabular and femoral component for all causes and revision of acetabular component for loosening.

Both cohorts of young (less than 55 years) and old (more than 55 years) patients were compared in using Log-rank test. The test was considered as significant if *p*-value was less than 0.05.

Table 1 Patients characteristics at index surgery

Patients characteristics	Less than 55 years <i>n</i> = 119	More than 55 years <i>n</i> = 444	<i>p</i> -value
Mean age at primary THA (range)	49.9 years (18–55)	72.31 years (56–97)	<0.05
Women (%)	33.3 %	62.3 %	<0.05
Mean BMI (range)	25.7 kg/m ² (17.7–44.7)	25.9 kg/m ² (15.8–39.6)	NS*
Etiology (%)			<0.05
Osteoarthritis	54.3	84.7	
Dysplasia	25	4.7	
Osteonecrosis	12.9	5.4	
Fractures	0	0.7	
Other	7.8	4.5	

* Not significant

Results

In cohort 1 there was only one case of infection (0.8 %). The mean FU was 11 years (8 to 15 years). One hundred three THA on file for 91 patients were reviewed, which represents 86.5 % of the initial cohort.

Two stems were revised due to mechanical failure (1.6 %) (without cup revision) and two cups due to loosening at ten and 13 years FU, without stem revision for these patients.

The survival rate relating to both components at 13.9 years was 96.1 % [91.8–100 %] with failures for all causes as endpoint (Fig. 2a). The survival rate relating to the acetabular component at 13.96 years was 98.4 % [95.3–100 %] with acetabular retrieval and implant-related failure as endpoint (Fig. 2b).

In cohort 2 there were only two cases of infection (0.45 %). The mean FU was 12.45 years (10 to 15.4 years). Two hundred seventeen THA on file for 210 patients were reviewed, which represents 48.76 % of the initial cohort.

Two stems (Viso) were revised for loosening and two for proximal femoral fractures (without cup revision). Five cups were revised for aseptic loosening (1.12 %) at 9 years (two cases), ten, 12 and 13 years.

The survival rate relating to both components at 15.5 years was 95.6 % [93.1–98.2 %] with failures for all causes as endpoint (Fig. 2c). The survival rate relating to the acetabular component at 15.5 years was 98.4 % [96.8–100 %] with acetabular retrieval and implant-related failure as endpoint (Fig. 2d).

The difference between the survivorship of both cohorts is not statistically significant ($p > 0.05$).

No case of dislocation was observed, nor any case of intraprostatic dislocation (IPD) in both cohorts.

In preoperative stage DEVANE classification as well as HHS, PMA and OXFORD scores were comparable ($p > 0.05$) between both cohorts (Table 2). In post-operative stage, DEVANE classification and HHS, PMA and OXFORD scores improved significantly ($P < 0.05$) both in patients aged less than 55 years and in patients aged more than 55 years.

The radiographic analysis of the study of cohort 1 has provided eight cases of osteolysis (7.7 %) without revision; four limited to the acetabulum (scalloping in zone 1), two on the calcar area and two bipolar but limited (Fig. 3). No evident case of visible wear of the cup was observed.

The radiographic analysis of the study of cohort 2 provided 16 cases of osteolysis (3.60 %) without revision; three limited to the acetabulum (scalloping in zone 1), six limited to the calcar area, one femoral proximal osteolysis (without relationship with visible PE wear) and six bipolar (great trochanter, calcar and acetabular lucent lines or geodes): five in relationship with visible PE wear assessed by the Chevrot-kerboull method from 1.14 mm to 2.20 mm with a mean wear penetration of the inner articulation of 1.45 mm. The mean FU of these cases is 12.8 years (Fig. 3).

Discussion

- 1) Are there more complications at more than ten years of FU for this series of young patients compared to the series (444) for older patients?

In spite of young age, difference in aetiology (less OA and more ONA) and more activity level, there are no more complications in the series of patients under 55 years than in the older one. The survivorships were similar. There is no dislocation and no IPD in either case.

There is not more infection in the series of older patients.

- 2) Is there more difference with the other series of DMC at the same FU?

If we compare our results to other DMC series at ten years of FU minimum whatever the age, the rate of dislocation is within the same range:

Prudhon [7] 0.95 %, Leclerc [8] 0 %, Vielpeau [9] 1.16 % (16.5 years FU), Caton [10] comparative series with or without DMC 0.95 % versus 12.7 % and Philippot [11] 2 %, Boyer [12] 0 %, Lautridou [13] 1.1 % and

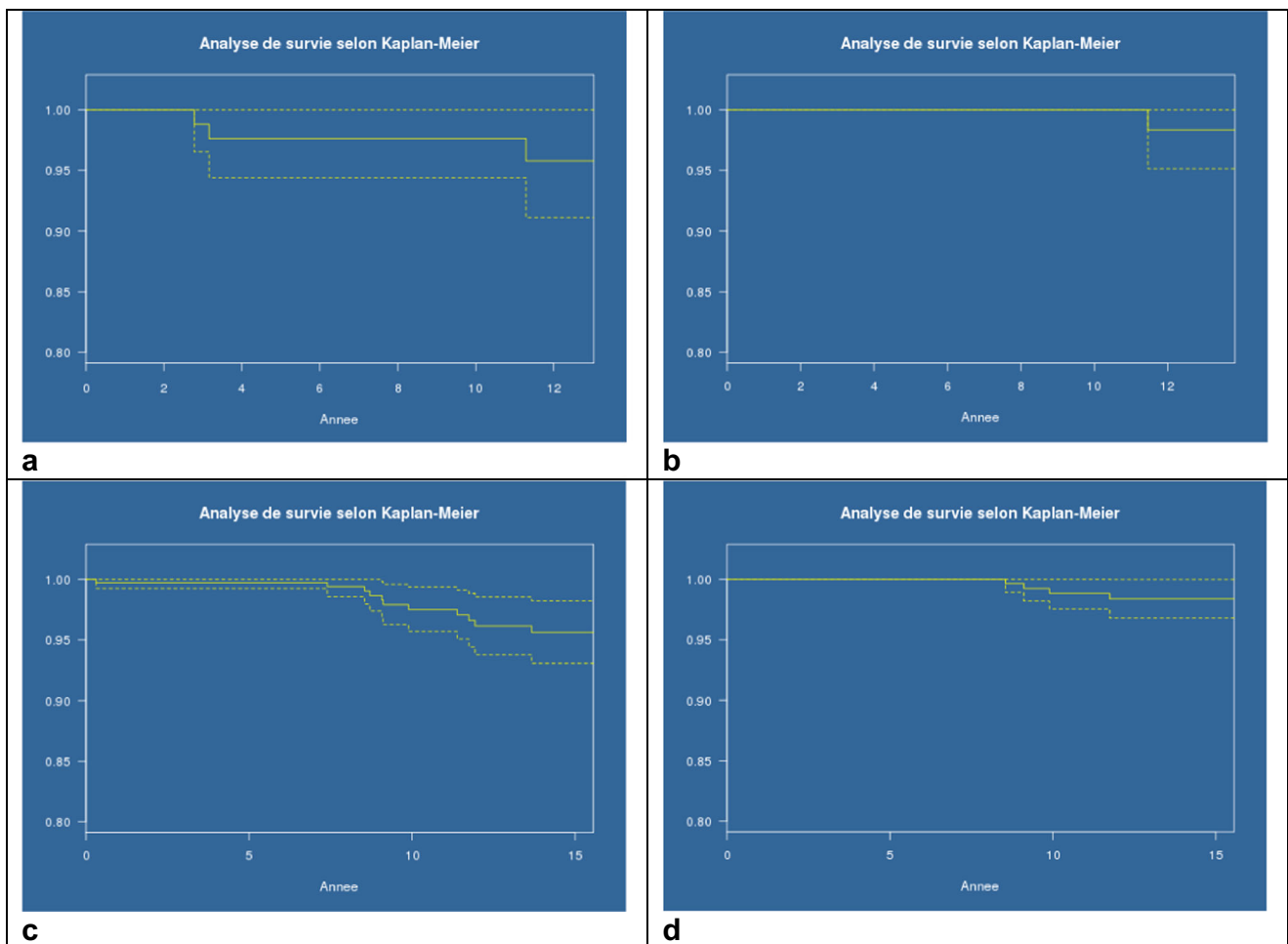


Fig. 2 **a** < 55 years — survivorship of both components failures of all types **b** < 55 years — survivorship of acetabular components failures due to aseptic loosening **c** > 55 years — survivorship of both components

failures of all types **d** > 55 years — survivorship of acetabular components failures due to aseptic loosening

Farizon [14] 0.74 % at ten years FU.

There is only one series of DMC for young patients, Philppot (to be published in International Orthopaedics)

with a survival rate of 77 % at 20 years FU with no dislocation but these are the results of the original Bousquet’s DMC with alumina coating. Our survival rate

Table 2 Pre and post-operative scores

Patients characteristics	Less than 55 years <i>n</i> = 119		More than 55 years <i>n</i> = 444	
	Preop	Postop	Preop	Postop
Mean HHS (range)	39.5 (10–70)	98.0 (83–100)	43.9 (12–71)	95.6 (56–100)
Mean PMA, (range)	8.8 (4–15)	17.0 (16–18)	9.22 (4–16)	17.4 (11–18)
Mean Oxford (range)	45.6 (37–53)	13.5 (12–38)	41 (31–52)	13.8 (12–43)
Devane (%)				
Sedentary	10.2	0	7.9	3.6
Semi-sedentary	56.8	2.8	69.1	18.9
Leisure activities	27.1	17.7	20	40.5
Light jobs	4.2	55.2	2.4	32.9
Strenuous labor	1.7	24.3	0.6	4.1

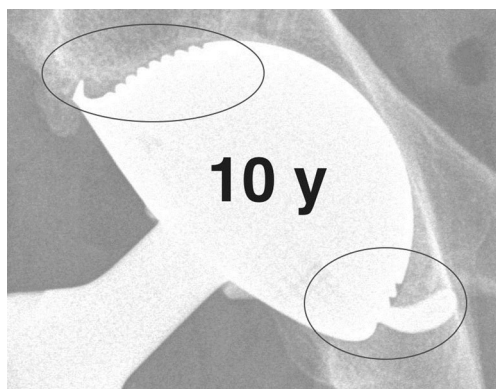


Fig. 3 Gyros cup at 10 years of follow-up with osteolysis and loosening

is better but the DM cup used in our series is a second generation of DMC.

- 3) Are there differences with the other bearing at the same FU?

First of all, we must consider the result of “the gold standard” which is Charnley LFA, (Kerboull [15]): 99 % of survivorship at ten years FU, and 0.46 % of dislocation and almost the same for Wroblewski [16] 96.9 % at 13.5 years with a dislocation rate of 1.6 % (for Kerboull and Wroblewski there is an approach with trochanterotomy).

Concerning classic bearing alumina/PE and cementless (hydroxyapatite-coated stem and threaded cup), we have found only one recent publication by Almeida [17] with 88 % of cumulative survival at ten years FU using cup revision as the end point (dislocation rate not reported). This result is the same as in the Finnish Register [18] whatever the age (88.3 to 91 % at ten years of FU).

Hard/hard bearings are most commonly used for young patients.



Fig. 4 Quattro DMC (groupe lépine, Genay, France)

With ceramic on ceramic bearing, Bizot [19], Boyer [20] and Chana [21] reported a survivorship rate of respectively 92, 91 and 96.5 % at ten years FU but with a dislocation rate of 3.9 to 2.8 %.

With metal on metal bearing, Delaunay [22] note that there is a 99 % survivorship rate at 15 years but always with a dislocation rate (1.2 %).

So we agree with Epinette [23] that modern DMC is a valuable option to reduce instability after primary hip arthroplasties in younger patients but the FU of these patients is shorter than ten years.

However, there are some cases of osteolysis in this series. The GYROS DMC is a cup of 2nd generation stainless steel (not in cobalt-chrome); but neither its primary stability nor its bone ingrowth (HA monolayer), probably, are perfect. Major bipolar osteolysis seems in relation with PE wear of the little articulation.

To avoid osteolysis and to improve the long-term results, a prospective series of 3rd generation DMC (Quattro) was initiated in 2013 with a cobalt-chrome metallic shell, a double-layer titanium plasma spray and HA, no screw, no hole, a standard sterilized PE liner sterilized by gamma irradiation in double vacuum pouches and a true chamfer to optimize the contact with the rounded and highly polished neck of the stem (Fig. 4).

DMC remains for young patients a relevant surgical option with no dislocation and an excellent survival rate at mid-term FU.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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Ethical approval For this type of study formal consent is not required

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