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Cup Press Fit in Uncemented THA Depends on Sex, Acetabular Shape, and Surgical Technique

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Abstract

Background Uncemented press-fit cups provide bone fixation in primary THA, but the use of screws is sometimes necessary to achieve primary stability of the socket. However, it is unclear whether and when screws should be used.

Question/Purposes We analyzed the factors related to screw use with a press-fit uncemented cup and assessed whether screw use is associated with the same rates of loosening and revision as a press-fit technique.

Methods We retrospectively reviewed 248 patients who underwent THA using the same prosthetic design. Eighty-eight hips had screws to achieve primary cup fixation (Group 1), and 189 did not (Group 2). Mean age was 50 years (range, 14–73 years). We analyzed factors related to the patient, acetabular type, and reconstruction of the rotation center of the hip. Minimum followup was 5 years (mean, 8.9 years; range, 5–12 years).

Results We found higher screw use in women, patients with less physical activity, Acetabular Types A or C, and a distance from the center of the prosthetic femoral head to the normal center of rotation of more than 3 mm. There were four revisions in Group 1 and five in Group 2. Eight hips had radiographic loosening in Group 1 and nine in Group 2. Cups with a postoperative abduction angle of more than 50° had a higher risk for loosening.

Conclusions Press fit was achieved less frequently in women and patients with Acetabular Types A or C and less physical activity; a closer distance to the normal center of rotation decreased screw use. Screw use to augment fixation achieved survival similar to that of a press-fit cup.

Level of Evidence Level II, prognostic study. See Instructions for Authors for a complete description of levels of evidence

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Introduction

Porous-coated and other hemispherical designs are associated with high rates of stable fixation in primary THA [13, 14], with rates of aseptic loosening at 10 years of followup of less than 5% [3, 12, 42]. Although controversial [9], screws have been recommended for additional fixation [25, 36]. Their disadvantages include the risk of injury to major neurovascular structures [1, 38] or possible access for wear particle-producing osteolysis and the appearance of radiolucent lines around screws [28, 30].

Various factors influence the primary fixation of hemispherical uncemented cups. The geometry of the socket is altered in the arthritic hip due to the degenerative process, which may affect cup fixation [6, 34]. Bone quality and female

sex have been postulated as factors influencing primary uncemented fixation [8]. When a hemispherical uncemented cup is used with a press-fit technique without screws, the acetabular bone preparation and loading at the cortical rim of the acetabulum are critical [8, 9, 23]. In a long-term study of 4289 uncemented cups, Engh et al. [9] observed a survivorship of higher than 90% at 15 years for six different designs; the highest survival rates were for press-fit components. Although they did not describe the technical differences between cups with spikes and those with or without screws, they observed a lower survival for the cups with spikes, probably due to an incomplete seating of the component in the acetabulum. Dorr et al. [6] reported the acetabular structure is different in the arthritic hip and this could be related to cup fixation, as well as the depth of reaming and the importance of loading of the cortical rim of the acetabulum. However, it is unclear whether and when screws should be used.

We therefore first analyzed the possible relationship between factors related to patient demographics (age, sex, physical activity, weight, diagnosis), their preoperative radiographic characteristics (acetabular geometry and bone quality), surgical technique according to the reconstruction of the rotation center of the hip on the postoperative radiographs, and the primary fixation using a press-fit technique of an uncemented hemispherical hydroxyapatite (HAP) cup in primary THA. Second, we compared the postoperative pain, function, and ROM and the rates of revision and radiographic loosening of the cups implanted with or without screws to augment primary fixation over a minimum followup of 5 years.

Patients and Methods

We prospectively followed all 257 patients with 289 primary THAs using the same prosthetic design between January 1999 and January 2006. A minimum time of 5 years from the operation (including radiographs) was required for inclusion in this followup study. Nine patients (12 hips) were lost to followup and were excluded. The remaining 277 hips (248 patients) formed the basis of the followup study. The patients were divided into two groups depending on whether screws were used to achieve intraoperative primary fixation of the cup: Group 1, who had screws (89 hips); and Group 2, who did not (189 hips). Mean age was 50.6 years (range, 14–73 years). The minimum clinical and radiographic followup at the last evaluation was 5 years in nonrevised hips (mean, 8.9 years; range, 5–12 years). Oral and written informed consent for participation in the study was obtained from all patients.

We collected patient demographic data in terms of sex, age, weight, activity level, acetabular shape, preoperative diagnosis, and clinical status. The preoperative activity level was classified according to Devane et al. [5]. We used the classification of Dorr et al. [6] to assess acetabulum morphology according to the shape of the radiolucent triangle superior to the acetabulum (Table 1): Type A is an isosceles-triangle-shape seen more frequently in hips with avascular necrosis and inflammatory arthritis; Type B shows extension of the triangle into the teardrop seen more frequently in osteoarthrosis of the hip; and Type C is a right triangle seen more frequently in dysplastic hips. Preoperative radiographs were measured for Types 1, 2, and 3 femoral bone [7] so as to evaluate the influence of osteoporosis on bone fixation.

A Cerafit®-Triradius press-fit cup (Ceraver, Roissy, France), including a fully HAP-coated $TiAl_6V_4$ rough shell with optional screws and fitted with an Al_2O_3 liner, was implanted in every hip. The cup was paired with an uncemented fully HAP-coated, tapered, straight Cerafit®-Multicone stem (Ceraver). According to the manufacturer,

Table 1. Distribution of acetabular type [6] according to diagnosis

Diagnosis	Number of hips			Total	p value
	Type A	Type B	Type C		
Osteoarthrosis	36 (24.0%)	111 (75.3%)	0	147	< 0.001
Primary osteoarthritis	24 (21.6%)	87 (78.4%)	0	111	
Developmental arthritis	7 (43.8%)	9 (56.3%)	0	16	
Posttraumatic arthritis	5 (25.0%)	15 (75.0%)	0	20	
Congenital dysplasia	5 (15.6%)	8 (25.0%)	19 (58.4%)	32	
Moderate dysplasia	5 (21.7%)	8 (34.8%)	10 (43.5%)	23	
Severe dysplasia	0	0	9 (100.0%)	9	
Inflammatory arthritis	28 (75.7%)	9 (24.3%)	0	37	
Avascular necrosis	43 (74.1%)	15 (25.9%)	0	58	
Other	0	2 (66.7%)	1 (33.3%)	3	
Total	112 (40.4%)	145 (52.3%)	20 (7.2%)	277	

the alumina had 99.8% purity, 3.98 density, 2-μm grain size, and was manufactured by hot isostatic pressing in all cases. The HAP coating was sandblasted to increase the implant surface for osseointegration, a relative crystallinity of 37%, a thickness of 80 ± 20 μm, a bond shear strength of 15 to 25 MPa, and a mean roughness of 3 μm; the arithmetic rugosity (Ra) beneath the HAP was 3 to 4 μm [11]. The femoral head size was 28 mm for cups sized 46 or 48 mm in diameter (20 cups) and 32 mm for cups sized 50 mm or greater (257 cups). We use this implant for patients aged 65 years or older and active patients (Activity Level 4 or 5 according to Devane et al. [5]).

Two surgeons (EGC, ACP) performed all operations with the same operative technique using a posterolateral approach. In all patients, we prepared the acetabular bone by removing the central osteophyte and reaming the articular cartilage until subchondral bone started bleeding. We attempted to maintain the subchondral bone [41]. The reaming was made line-to-line due to the oversized cup following the manufacturers′ recommendations. We first tried a press-fit implantation of the cup. The intraoperative stability of fixation was confirmed according to Udomkiat et al. [35] by trying to pull the metal shell out of the acetabulum using the attached insertion tool (pull-out test). Two screws were used if there was any movement after the mentioned technique and/or where autograft was employed.

After surgery, patients walked with crutches with toe-touch partial weightbearing for 3 weeks, after which they were allowed to walk using two crutches for the next 6 weeks. Cefazolin (or vancomycin in allergic patients) was administered for antibiotic prophylaxis during the anesthetic induction and continued for 24 hours, with low-molecular-weight heparin to decrease the risk of thromboembolic disease in all patients for 5 weeks postoperatively.

Patients were followed postoperatively at 6 weeks, 3, 6, and 12 months, and annually thereafter. We evaluated preoperative and postoperative pain, function, and ROM according to the six-level scale described by Merle d'Aubigné and Postel [20]. Patients were also asked about the location of pain when reported. Standard AP radiographs of the pelvis and lateral radiographs of the hip were made preoperatively, immediately after the operation, at 6 weeks, at 3, 6, and 12 months, and annually thereafter following the same protocol. The patient was positioned supine with his/her feet together. The x-ray tube was positioned over the symphysis pubis 1 m from and perpendicular to the table with a symmetric obturator foramen and visible lesser trochanter and iliac crest [19]. A single author (EGR) who had not been involved in the surgery made all measurements, which were repeated three times for every radiograph. Cup position was assessed according to the acetabular abduction angle, the height of the center of the hip (as measured from the center of the femoral head to the interteardrop line), and the horizontal distance of the cup (measured from the center of the femoral head to the Kohler line) [15]. The reconstruction of the hip rotation center was evaluated according to the Ranawat triangle [26]. The true acetabulum region was the area enclosed by a right triangle with a height and width equal to 20% of the height of the pelvis on the AP radiograph. The midpoint of the hypotenuse coincides with the approximate center of the femoral head (AFHC) and is the center of rotation of the hip. The AFHC was used as the reference point to measure distance to the center of the prosthetic femoral head (CPFH). This distance was recorded in the preoperative and postoperative radiographs to assess the reconstruction actually achieved. The distribution of any radiolucent gaps on the initial postoperative radiograph and of radiolucent lines or osteolysis at the acetabular bone-prosthesis interface on the subsequent radiographs was recorded in the three zones described by DeLee and Charnley [4]. The current method of determining radiographic stable bone fixation into an acetabular component is by indirect inference based on the absence of the two classic signs of loosening: radiolucent lines and cup migration [21].

We expressed nominal data as frequencies or percentages and quantitative data as mean ± SD. We compared qualitative data for hips with and without screws using the chi square test or Fisher's exact test and quantitative data using Student's t-test. Pearson's chi square test was used to compare the demographic qualitative data of patients between groups. Univariate and multivariate Cox regression models were used to assess risk factors for the use of screws. We used Kaplan-Meier survivorship analysis [16], with 95% CIs, to estimate the cumulative probability of not having a revision of one or both prosthetic components and to estimate the cumulative probability of not having cup loosening. The differences in survival with and without screws were assessed using the log-rank test to compare the Kaplan-Meier curves. We performed statistical analysis using SPSS® software (Version 9.0; SPSS Inc, Chicago, IL, USA).

Results

We found differences in sex, weight, activity level, and acetabular and femoral types between patients receiving screws (Group 1) and those not receiving screws (Group 2) (Table 2). Postoperative radiograph analysis showed a difference between groups in only mean CPFH to AFHC distance (Table 3). Multivariate analysis showed higher screw use in women (odds ratio [OR], 2.39; 95% CI, 1.1–5.21), patients with lower physical activity (OR, 0.54; 95% CI, 0.37–0.79), Acetabular Type A (OR, 3.46; 95% CI, 1.72–6.93) or C (OR, 5.19; 95% CI, 1.5–17.97), and a CPFH to AFHC distance of 3 to 5 mm (OR, 3.53; 95% CI,

Table 2. Preoperative patient data and use of screws

Variable	Screws (n = 88)	No screws (n = 189)	Total (n = 277)	p value
Sex				< 0.001‡
Male	39 (23.3%)	128 (76.6%)	167	
Female	49 (44.5%)	61 (55.5%)	110	
Age (years)*	47.9 ± 15.9	51.9 ± 12.3	50.6 ± 13.7	0.121§
Weight (kg)*	69.5 ± 12.9	74.9 ± 11.1	73.2 ± 11.9	0.001§
Side				0.796‡
Right	48 (37.6%)	99 (67.3%)	147	
Left	40 (30.8%)	90 (69.2%)	130	
Activity level [5]				< 0.001‖
1	5 (83.3%)	1 (16.7%)	6	
2	5 (48.5%)	8 (61.5%)	13	
3	14 (48.3%)	15 (51.7%)	29	
4	51 (37.5%)	85 (62.5%)	136	
5	13(14.0%)	80 (86%)	93	
Acetabular type [6]				< 0.001‖
A	48 (42.9%)	64 (57.1%)	112	
B	27 (18.6%)	118 (81.4%)	145	
C	13 (65.0%)	7 (35.0)	20	
Femoral type [7]				0.034
1	48 (27.4%)	127 (72.6%)	175	
2	25 (34.2%)	48 (65.6%)	73	
3	15 (51.7%)	14 (48.3%)	29	
Diagnosis				
Osteoarthrosis	26 (23.4)	85 (76.6%)	111	
Developmental arthritis†	6 (37.5%)	10 (62.5%)	18	
Posttraumatic arthritis	5 (25.0%)	15 (75.0%)	20	
Moderate dysplasia	12 (52.2%)	11 (47.8%)	23	
Severe dysplasia	4 (44.5%)	5 (55.5%)	9	
Inflammatory arthritis	19 (51.4%)	18 (48.6%)	37	
Avascular necrosis	15 (25.9%)	43 (74.1%)	58	
Other	1	2	3	
Merle d'Aubigné-Postel score [20]				
Pain	2.3 ± 0.9	2.7 ± 0.7	2.6 ± 0.8	0.418
Function	3.0 ± 1.1	3.0 ± 1.0	3.0 ± 1.0	0.821
Range of movement	2.7 ± 0.8	2.7 ± 0.9	2.7 ± 0.9	0.644

* Values are expressed as mean ± SD; the remaining values are expressed as number of hips, with percentage in parentheses; †arthritis secondary to Legg-Calvé-Perthes disease, septic arthritis in children, and slipped capitis femoral epiphysis; ‡Fisher exact test; §Student's t-test; ‖Pearson chi square test.

Table 3. Postoperative radiograph data for both groups

Variable	Screws	No screws	Total	p value
Abduction acetabular angle (°)	47.3 ± 6.7	45.6 ± 4.7	46.2 ± 5.5	0.008
Horizontal distance (mm)	33.9 ± 6.9	33.7 ± 5.4	33.8 ± 5.9	0.492
Vertical distance (mm)	22.4 ± 7.7	21.1 ± 6.2	21.5 ± 6.7	0.161
Mean CPFH-AFHC distance (mm)	4.3 ± 4.6	1.7 ± 1.9	2.6 ± 3.3	< 0.001

Values are expressed as mean ± SD; CPFH = center of the prosthetic femoral head; AFCH = approximate center of the femoral head.

Table 4. Multivariate Cox regression analysis and risk factors for screw use

Risk factor	Nonadjusted univariate			Adjusted multivariate		
	p value	Odds ratio	95% CI	p value	Odds ratio	95% CI
Sex	< 0.001			0.028		
Male		1			1	
Female		2.54	1.57, 4.43		2.4	1.1, 5.21
Acetabular type [6]	< 0.001			< 0.001		
B		1			1	
A		3.07	1.06, 5.66		3.46	1.72, 6.94
C		21.43	8.38, 54.77		5.19	1.5, 17.97
Femoral type [7]	0.034			0.723		
1		1				
2		1.38	0.77, 2.48			
3		2.83	1.27, 6.31			
CPFH-AFHC distance	< 0.001			< 0.001		
< 3 mm		1			1	
3–5 mm		3.28	1.87, 5.74		3.54	1.76, 7.13
> 5 mm		8.12	2.96, 22.27		34.79	11.46, 105.56
Weight	0.001	0.961	0.939, 0.983	0.35		
Activity level	< 0.001	0.518	0.385, 0.698	< 0.001	0.55	0.38, 0.79
Acetabular abduction angle	0.027	1.06	1.01, 1.12	0.965		

CPFH = center of the prosthetic femoral head; AFCH = approximate center of the femoral head.

Table 5. Postoperative Merle d'Aubigné-Postel scores [20]

Domain	Score (points)			p value
	Screws (n = 88)	No screws (n = 189)	Total	
Pain	5.8 ± 0.6	5.9 ± 0.6	5.8 ± 0.6	0.047
Function	5.7 ± 0.6	5.8 ± 0.6	5.8 ± 0.6	0.284
ROM	5.6 ± 0.7	5.7 ± 0.7	5.7 ± 0.7	0.011

Values are expressed as mean ± SD.

1.75–7.12) or greater than 5 mm (OR, 34.78; 95% CI, 11.46–105.56) (Table 4).

We observed lower (p = 0.047 and p = 0.011, respectively) mean postoperative ratings for pain and ROM in Group 1 (Table 5). The survival rate for revision surgery for any cause at 12 years was 95.4% (95% CI, 91%–99%) in Group 1 and 97.8% (95% CI, 95%–99%) in Group 2 (p = 0.41) (Fig. 1). There were four revisions in Group 1 and five in Group 2; all revisions were performed due to aseptic loosening of the cup. Seventeen patients (eight in Group 1, nine in Group 2) had radiographic cup loosening (Table 6). The probability of not having radiographic loosening at 12 years was 90.9% (95% CI, 84%–96%) in Group 1 and 95.1% (95% CI, 92%–98%) in Group 2 (p = 0.14) (Fig. 2). Cups with an acetabular abduction angle of higher than 50° were associated with (p = 0.042; hazard ratio, 3.177; 95% CI, 1.045–9.661) radiographic

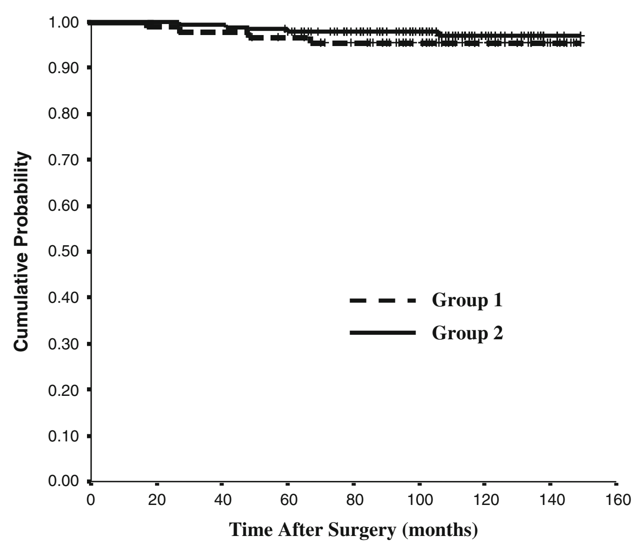

Fig. 1 A graph shows Kaplan-Meier survivorship curves comparing the cumulative probability of not having a cup revision for any cause in patients with screws (Group 1) and without screws (Group 2). The survival rate for revision surgery for any cause at 12 years was 95.4% (95% CI, 91%–99%) in Group 1 and 97.8% (95% CI, 95%–99%) in Group 2 (p = 0.41). Cross lines represent censored hips.

loosening in both groups. The survival rate for radiographic loosening at 12 years was lower (p = 0.002) for these cups (Fig. 3). We also observed a tendency in men for a lower risk for loosening (p = 0.071) and a greater risk in cups with a CPFH to AFHC distance of more than 5 mm on the

Table 6. Data on patients with loosened cups

Patient	Sex	Age (years)	Weight (kg)	Activity level [5]	Acetabular type [6]	Diagnosis	Screws	Surgery details	Acetabular abduction angle (°)	Vertical distance (mm)	Horizontal distance (mm)	CPFH-AFHC distance (mm)	Loosening (months)	Revision surgery (months)
1	Female	67	69	2	B	Primary osteoarthritis	No		45	35	20	3	48	
2	Female	59	56	4	A	Inflammatory arthritis	Yes	Autograft	55	35	15	3	28	
3	Female	62	56	4	A	Inflammatory arthritis	Yes	Autograft	42	30	20	1	36	
4	Female	65	66	4	A	Posttraumatic	No		39	35	25	0	34	41
5	Male	51	60	5	B	Developmental arthritis	No	Previous osteotomy	45	37	30	6	75	
6	Male	51	60	5	B	Developmental arthritis	No	Previous osteotomy	45	30	14	4	78	
7	Male	28	66	5	C	Severe dysplasia	No	Previous osteosynthesis	42	20	20	2	36	
8	Female	46	56	4	C	Moderate dysplasia	Yes		55	25	30	8	10	27
9	Female	39	52	4	C	Severe dysplasia	Yes		40	50	50	8	12	
10	Female	29	60	2	C	Severe dysplasia	No		65	35	25	2	56	60
11	Male	34	74	5	B	Moderate dysplasia	No		45	38	22	6	40	48
12	Female	28	55	4	B	Developmental arthritis	Yes		50	30	25	14	52	67
13	Male	53	78	5	B	Avascular necrosis	No		45	40	25	4	20	106
14	Female	45	59	2	A	Inflammatory arthritis	Yes	Autograft	75	35	25	10	6	17
15	Female	21	52	1	A	Inflammatory arthritis	Yes	Autograft	52	40	20	2	22	
16	Female	60	65	4	B	Primary osteoarthritis	No		45	30	30	3	48	
17	Male	45	74	5	A	Avascular necrosis	Yes		47	35	25	−4	36	48

CPFH = center of the prosthetic femoral head; AFCH = approximate center of the femoral head.

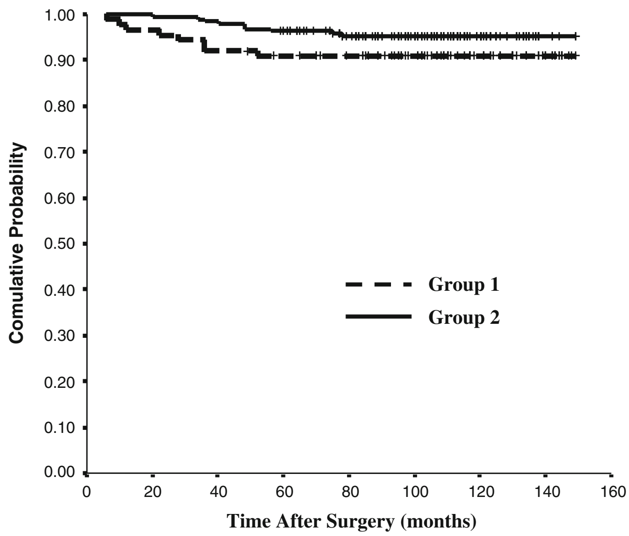

Fig. 2 A graph shows Kaplan-Meier survivorship curves comparing the cumulative probability of not having radiographic aseptic cup loosening in patients with screws (Group 1) and without screws (Group 2). The probability of not having radiographic loosening at 12 years was 90.9% (95% CI, 84%–96%) in Group 1 and 95.1% (95% CI, 92%–98%) in Group 2 (p = 0.14). Cross lines represent censored hips.

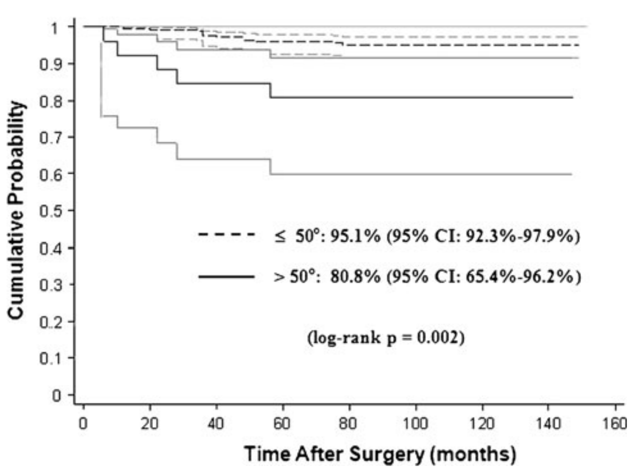

Fig. 3 A graph shows Kaplan-Meier curves comparing the cumulative probability (with 95% CIs) of not having radiographic aseptic cup loosening in patients with a postoperative acetabular abduction angle of 50° or less and higher than 50°. The survival rate for radiographic loosening at 12 years was lower (p = 0.002) for cups with an acetabular abduction angle of higher than 50°. Cross lines represent censored hips.

postoperative radiograph (p = 0.092). The Cox model showed no differences when acetabular type was assessed. Other factors related to screw use for primary cup fixation and the appearance of radiographic loosening are shown (Table 7).

Table 7. Multivariate Cox regression analysis and risk factors for aseptic loosening for both groups

Risk factor	Adjusted multivariate results		
	p value	Hazard ratio	95% CI
Sex	0.071	0.385	0.136, 1.087
Use of screws	0.687	0.789	0.249, 2.498
Acetabular type [6]			
A	0.27		
B	0.986	1.01	0.328, 3.113
C	0.14	2.67	0.724, 9.88
CPFH-AFHC distance			
< 3 mm	0.24		
3–5 mm	0.31	1.87	0.554, 6.320
> 5 mm	0.09	3.47	0.815, 14.814
Acetabular abduction angle > 50°	0.042	3.17	1.045, 9.661

CPFH = center of the prosthetic femoral head; AFCH = approximate center of the femoral head.

Discussion

Although uncemented press-fit cups obtain primary bone fixation [8, 9], there are some conditions that may preclude obtaining a primary stability of the implant [35]. We analyzed the possible relationship between factors related to patients and the reconstruction of the rotation center of the hip with press fit for uncemented hemispherical cup in primary THA; we also compared the postoperative pain, function, and ROM and rates of revision and radiographic loosening after a minimum followup of 5 years between cups implanted with or without screw fixation.

There are several limitations to our study. First, although the mean followup was 8.2 years, we know in vivo effects of screws (eg, contributing to osteolysis from wear debris) in augmenting cup fixation might appear later. Second, we had small numbers in our subcohorts. For example, the small number of Acetabular Type C hips provided some apparent trends that, in a larger cohort, could be different. The factors analyzed in the Cox model for screw use and aseptic loosening such as sex or acetabular reconstruction might have been clearer. Third, the surgical technique, although used by the same team following the same principles according to the pull-out test [35], may not be reproducible, leading to somewhat differing criteria for screw use. Fourth, this was not a prospective randomized trial, and the preoperative differences between groups may have influenced the comparisons.

Women had a higher rate of screw use, perhaps owing to the association with a greater frequency of osteoporotic bone [35]. Screw use was also more frequent in patients with a cylindrical femur [8]. Press fit was less frequently

achieved in patients with less physical activity, usually with osteoporotic bone or a diagnosis other than primary osteoarthritis [6, 10, 11]. Acetabular Types A and C had a higher rate for screw use than Type B. The thinner medial wall of Acetabular Type A, frequent in hips with avascular necrosis and in inflammatory arthritis, is associated with higher stress forces, so impaired stability has been reported [2]. In Acetabular Type C, frequent in dysplastic hips, complete coverage of the cup is often difficult, so good contact between cup and bone in the cortical rim is sometimes difficult to obtain [11]. Recently, Takao et al. [33] reported no aseptic loosening in a series with a press-fit cup without screws in dysplasia. They additionally stated superior bone-cup contact is important for the stability of uncemented cups because the weightbearing force is concentrated on the superior portion of the acetabular cup, and they noted press-fit-only fixation in a dysplastic acetabulum may be challenging because of the deficient bone [33]. Our series is a relatively young population in whom we used an alumina-on-alumina uncemented THA and the patient′s acetabular types are different from other reports [2, 6, 32]. The most important factor we observed was the postoperative position of the cup; a CPFH to AFHC distance of more than 3 mm was associated with a higher rate of screw use. The acetabulum must be reamed at the anatomic site to restore the acetabular anatomy and the anatomic center of hip rotation so as to obtain stable fixation of the prosthetic components [24, 37, 41]. Since a good postoperative position of the cup is desirable, this finding suggests the importance of surgical technique.

Patients with a press-fit cup without screws reported less pain and had better ROM; however, their pathologic preoperative conditions were not similar, so this finding must be interpreted with caution. We also observed the rate of revision and aseptic loosening at 12 years was similar regardless of screw use. One in vitro study [18] suggested the addition of supplemental screws did not improve the stability of uncemented cups under proper press-fit conditions. Press-fit acetabular implantation helps to distribute compressive forces to the periphery of the acetabulum, so most of these designs have a flattened pole area to facilitate complete seating and are oversized to optimize press fit [22, 27, 39]. Won et al. [40] observed in the laboratory the use of screws increases micromotion at the opposite side of the screw due to distractive cyclic loads, and all cyclic loads were compressive in the press-fit component. There have been a few comparative clinical studies [6, 9, 23, 29–31] (Table 8). In a radiostereometric study, Önsten et al. [23] reported no differences at 2 years when screws were used. Roth et al. [29] reported there were no advantages in using screws with a press-fit cup and fewer radiographic changes in cups without screws. They concluded there could be more micromotion in a hip with a cup implanted with screws. Schmalzried et al. [31] observed a press-fit technique is effective in reducing the incidence of radiolucency. Kress et al. [17], in a study with CT-assisted osteodensitometry (using the same designs as in our series), reported nonprogressive bone radiolucent lines that were not related to the appearance of loosening of this cup. Several studies [22, 42] suggest it is important to maintain the subchondral bone to reduce the risk of cup migration. Since a vertical cup with an acetabular angle of greater than 50° was the most important factor related to aseptic loosening and a tendency for a closer distance to the approximate center of the hip rotation was also observed, we emphasize the importance of the surgical technique.

Table 8. Clinical studies of uncemented cups with and without screws

Study	Number of hips	Cup*	Press fit/Screws (number of hips)	Mean followup (years)	Aseptic loosening (number of hips)	Radiographic changes
Önsten et al. [23]	30	Omnifit®	20/10	2	0	No differences (RSA); polar gap (press fit)
Dorr et al. [6]	132	APR®	78/54	6.5	0	Radiolucent lines (screws); progressive; Zones 3 and 1
Schmalzried and Harris [30]	83	Harris-Galante® with screws	0/83	5	0	Radiolucent lines in Zone 3 (49); progressive; related to gap
Schmalrzied et al. [31]	122	Harris-Galante® press fit	122/0	5	0	Radiolucent lines in Zone 2 (20)
Engh et al. [9]	4289	Arthropor®, Duraloc®, others	3612/427	Range: 1–15	Survival: 100/98.4	
Roth et al. [29]	211	Duraloc®	101/101	5	0	Polar gap (press fit); radiolucent lines and sclerosis (screws)

Cups include Omnifit® (Stryker Orthopaedics, Mahwah, NJ, USA), APR® (Zimmer, Inc, Warsaw, IN, USA), Harris-Galante® (Zimmer), Arthropor® (Joint Medical Products, Stamford, CT, USA), and Duraloc® (DePuy Orthopaedics, Inc, Warsaw, IN, USA); RSA = radiostereometric analysis.

We conclude the initial press fit of an uncemented cup depends on several factors. Women, patients with less physical activity, and patients with an acetabulum with a thin medial wall and dysplastic hips had higher rate of screw use. When comparing the survival rate for revision and aseptic loosening, we observed the use of screws in hemispherical cups, when primary stability is not obtained, provided a rate of loosening similar to that of cups implanted with a press-fit technique; although the screws are useful for the purpose of providing initial stability of the cup, in some cases, they were not enough to avoid loosening. Vertical cups were at greater risk for aseptic loosening, so we recommend a careful technique when using an uncemented cup in primary THA.

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