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Original Article

Mid-term clinical results of total hip arthroplasty using a Wagner standard cup for dysplastic hip

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ABSTRACT

Background: The outcome of cementless total hip arthroplasty depends on many factors. We must not forget fundamental things those are design of outer surface of the component, that leads bone ingrowth into the prosthesis, better initial stability, and better insertional techniques. The purpose of this study was to review our experience with metal-on-metal total hip arthroplasty with a Wagner standard cup for patients who had acetabular dysplasia.

Patients and methods: Fifty-four patients with 55 hips underwent primary metal-on-metal total hip arthroplasty (Metasul prosthesis) with a Wagner standard cup (44–48 mm in outer diameter) and were followed for a minimum of 10 years. All patients received the same type of cementless femoral component (Natural hip stem) and femoral head (28 mm in diameter).

Results: Seventeen of the 55 Wagner standard cups (30.9%) showed aseptic loosening over a mean period of 3.6 years after surgery, and there were no bone anchors on the outer surface of the 16 retrieved cups.

Conclusion: From our experience, the small Wagner standard cup does not achieve sufficient osteointegration and we do not recommend the use of this cup, especially for patients with acetabular dysplasia and/or those with a small stature.

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1. Purpose

The outcome of cementless total hip arthroplasty depends on many factors, including patient selection, surgical technique,

component design, and pairing of the articulating surface. In order to reduce polyethylene debris from the articulating surface and increase the longevity of total hip prostheses, metal-on-metal prostheses have been reintroduced. However, we don't take only care of the polyethylene debris which

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causes aseptic loosening, we must not forget fundamental things those are design of outer surface of the component, as well as porous-coated prosthesis, that leads bone ingrowth into the prosthesis, better initial stability, and better insertional techniques.

The purpose of this study was to review our experience with metal-on-metal total hip arthroplasty with a Wagner standard cup for patients who had acetabular dysplasia.

2. Patients and methods

Between November 1997 and April 2001, 110 consecutive patients (116 hips) underwent primary total hip arthroplasty with the Metasul metal-on-metal prosthesis. All patients received the same type of femoral head and stem. The femoral head was made of Co–Cr alloy (Protasul-21 WF) and was 28 mm in diameter, while the stem was a Natural Hip Stem made of titanium alloy (Ti6Al4V) with a proximal circumferential porous coating. We used one of two acetabular components for the Metasul prosthesis, either an APR cup or a Wagner standard cup. Since the Japanese physique is smaller than that of Europeans and Americans, and since dysplastic hip is common in Japanese women, a socket with a diameter of less than 50 mm is often employed. The Wagner standard cup is available with an outer diameter from 44 mm, but the APR cup for the Metasul prosthesis is only manufactured with a diameter ≥ 49 mm, so the Wagner standard cup needs to be used when a small diameter is required. Therefore, components were selected on the basis of the outer diameter of the acetabulum, with the Wagner standard cup being used when this was less than 49 mm. As a result, the Wagner standard cup was used in 55 hips. However, there was a difference in the structure of the outer surface between the APR cup and the Wagner standard cup. The APR cup had a porous-coated surface, but the Wagner standard cup has a characteristic sandblasted outer surface and a thin metalback from which multiple screw holes and small pyramid-like pegs project (Fig. 1). All of the prostheses were implanted without cement.

The mean age of the one man and 53 women (including one woman who underwent bilateral surgery) who underwent total hip arthroplasty with a Wagner standard cup was 59.2 ± 9.2 years (range: 29–77 years) at the time of operation. Fifty-one hips had osteoarthritis secondary to acetabular dysplasia (all 51 hips were classified as Crowe I or II dysplastic hips), 2 had rheumatoid arthritis, and 2 had osteonecrosis of the femoral head. The mean height, weight, and body mass index (BMI) was 150.6 ± 5.9 cm, 51.6 ± 8.4 kg and 22.7 ± 3.4 , respectively, while the mean duration of follow-up was 12.3 years (range; 11.2–13.4 years) (Table 1).

All procedures were performed via a posterioior approach with the patient in the lateral position. In patients with Crowe I hips, surgical plan was to place the acetabular component in the true acetabulum without augmentation. In patients with Crowe II hips, medialization of the acetabular component was done to obtain sufficient lateral coverage or reconstruction of a false acetabulum was performed at a high hip center. The acetabulum was reamed sequentially with reamers of increasing size until circumferential contact with bleeding cancellous or subchondral bone was obtained, with care being

Fig. 1 – Wagner standard cup. It has a characteristic sandblasted outer surface and a thin metalback from which multiple screw holes and small pyramid-like pegs project.

taken to preserve as much subchondral bone as possible. Using this technique, the acetabulum was underreamed by 2 mm in every hip (as recommended by the manufacturer). After a hemispherical cavity was prepared, the Wagner standard cup was impacted in approximately 45° of abduction and 15° of anteversion, while ensuring that at least 80% of the sandblasted surface of the cup was covered by host bone. The Wagner standard cup has a central hole and multiple screw holes that enable visualization of the fit and impaction was repeated until there was no gap between the reamed acetabular bone and the outer surface of the cup. Two or three 6.5 mm titanium alloy (Ti6Al4V) cancellous screws were used to augment fixation. None of the patients needed bone augmentation at the acetabular lim. Then the femoral component was inserted without bone cement. A 44 mm cup was used in 28 hips, a 46 mm cup was employed in 17 hips, and a 48 mm cup was inserted in 10 hips. Patients were

Table 1 – Demographic characteristics of the patients.

No. of hips (Male/Female)	55 (1/54)
No. of patients (Male/Female)	54 (1/53)
Mean age (range) (yrs.)	59.2 (29–77)
Initial diagnosis (Male/Female)	
Osteoarthritis	51 (0/51)
Osteonecrosis	2 (1/1)
Rheumatoid arthritis	2 (0/2)
Mean body weight (range) (Kg)	51.6 (38–76)
Mean body-mass index (range)	22.7 (16.9–34.2)
Femoral components	
Natural Hip Stem	55
Size of ball-head	
28 mm	55
Mean duration of follow-up (range)(yrs.)	12.3 (11.2–13.4)

advised to walk on crutches with partial weight-bearing for six weeks postoperatively.

The patients were evaluated radiographically every six months. Migration of the acetabular component was defined as a change of more than 3 mm in the horizontal or vertical direction, or a change of more than 3° in the cup angle. An approval was given by the institutional review board (IRB) and that informed consent was obtained from each patient or candidate.

3. Results

The radiographic loosening rate of the Wagner standard cup was a very high 30.9% (17/55 hips). The one man and 15 women (including one woman with bilateral loosening) who suffered from cup loosening had osteoarthritis secondary to acetabular dysplasia in 13 cases (including the woman with bilateral loosening), rheumatoid arthritis in 2 cases, and osteonecrosis of the femoral head in 1 case (Table 2). The mean age, height, weight and BMI at initial hip arthroplasty were 58.5 years (range: 29–77), 151.4 cm (range: 143–170), 54.2 kg (range: 38–65), and 23.6 (range: 18.3–27.8), respectively. The mean period from implantation to cup loosening was 43.7 months (range: 9–119) and the mean lateral cup angle at implantation was $44.2 \pm 5.7^\circ$. Loosening affected 12 out of 28 cups (42.9%) with a diameter of 44 mm, as well as 2 of 17 cups (11.8%) with a diameter of 46 mm and 3 of 10 cups (30%) with a diameter of 48 mm. The pattern of loosening was similar for all 17 cups. In each case, the cup rotated around a screw that acted as a fulcrum and the cup angle increased as a result. One or two screws were broken in 8 of the 17 loose cups. There was no radiographic evidence of periacetabular or perifemoral osteolysis in any of the patients with loose cups or the other patients with stable cups. Sixteen of the 17 loose Wagner standard cups and femoral heads were revised. At revision surgery, periacetabular osteolysis was not detected and the femoral component showed no clinical evidence of

loosening. Multiple culture samples were obtained during each procedure, but all were negative. There were no bone anchors on the outer surface of the retrieved Wagner standard cups, although the original sand-blasted surface had become smooth. The articular surfaces of the Metasul inlays and femoral heads showed scratches. While metallosis was not recognized around the joints, a small amount of metallosis due to friction between the metalback and the additional screws was recognized between the Wagner standard cup and the acetabulum.

4. Discussion

We used the combination of a Wagner standard cup and a Natural Hip Stem for Metasul metal-on-metal total hip arthroplasty, but other combinations of socket (i.e., APR cup, Interop cup, Alloclasic CSF cup, Armor cup, Durom cup, Fitek cup etc.) and stem (Zweymüller Alloclasic SL stem, APR stem etc.) could be used. There have been many reports concerning the results of Metasul metal-on-metal total hip arthroplasty, but only 3 authors used Wagner standard cup as far as we know.

Hwang et al¹ reported on the result for 78 Wagner standard cups after a mean follow-up period of 12.4 years and that the survival rate of the cup was 98.7% in patients younger than 50 years. Demmelmeyer et al² reported the clinical results for 102 Wagner standard cups after a mean of 12.0 years (range: 10–13.4 years). Their patients had various types of weight-bearing surface (polyethylene/ceramic, metal/metal, and polyethylene/metal in 25 cases, 68 cases and 25 cases, respectively), but the femoral head diameter was 32 mm for all patients. They stated that the overall survival rate of the Wagner standard cup at 12 years was 93.1% (95/102 hips) and they concluded this cup achieves very good long-term results. Kim et al³ reported that focal pelvic and femoral osteolysis was recognized in one patient each, but no radiographic loosening of components was seen after a mean follow-up

Table 2 – Data for 17 patients in whom the Wagner standard cup showed migration.

Patient	Age	Gender	Body height (cm)	Body weight (kg)	BMI	Diagnosis	Diameter of socket (mm)	Period from implantation to loosening (Mo)	Revision (yes/no)
1	54	F	154	58	24.5	RA	46	15	Y
2	66	F	147	52	24.1	OA	44	9	Y
3	49	F	144	38	18.3	OA	44	13	Y
4	49	F	158	51	20.4	OA	44	18	Y
5	55	F	153	65	27.8	ON	44	38	Y
6	29	M	170	64	22.1	ON	44	38	Y
7	75	F	152	52	22.5	OA	44	58	Y
8	64	F	152	53	22.9	OA	44	38	Y
9	52	F	153	48	20.5	OA	48	46	Y
10	44	F	156	53	21.8	OA	44	50	Y
11	66	F	143	50	24.5	OA	46	57	Y
12	77	F	147	55	25.5	OA	48	69	Y
13	74	F	148	59	26.9	OA	44	25	Y
14	51	F	152	52	22.5	RA	48	28	Y
15	66	F	154	56	23.6	OA	44	44	Y
16	50	F	150	57	25.3	OA	44	119	Y
17	74	F	148	59	26.9	OA	44	78	N

period of seven years in 68 hips. Despite reports of good results like these, the short to mid-term outcome with the Wagner standard cup in our series was poor, and 17/55 cups (30.9%) showed aseptic loosening over a mean period of only 4.6 years after surgery.

Many factors influence the occurrence of cup loosening, including patient factors, technical errors, and the design of the component. With regard to patient factors, 51 of the 55 (92.7%) patients in this series had osteoarthritis due to acetabular dysplasia. Concerning the rate of acetabular dysplasia among patients in the above-mentioned three studies, it was 20% in the study of Demmelmeyer et al,² 7.7% in that of Hwang et al,¹ and 8.8% (only mentioned as osteoarthritis) in that of Kim et al.³ We suppose that this difference in the prevalence of acetabular dysplasia could have influenced short- to mid-term results achieved with the Wagner standard cup. One of the major technical problems encountered during performance of total hip arthroplasty for congenital acetabular dysplasia is reconstruction of the acetabulum. Insufficient bone coverage influences the durability of the acetabular component, when a hemispherical component is inserted without cement. Hartofilakidis and Karachalios,⁴ as well as Anderson et al,⁵ have suggested that at least 70–80% osseous coverage of the acetabular component is required for stable fixation. Various surgical methods to achieve sufficient coverage of the cup have been tried and one method is placement of a small cup in a superior⁶ or protruding position.^{7–9} We took note of this point, and all 55 noncemented cups used in this series were inserted so that at least 80% of the sandblasted outer surface was covered by host bone and we obtained stable press-fit of the cup intraoperatively. We were also careful to place the acetabular components in a technically acceptable position with respect to the cup angle.

Reviewing the published results for small noncemented acetabular components, Cameron et al¹⁰ reported that there was no loosening of the shell (39–45 mm in outer diameter) in 34 patients with small stature after an average follow-up period of 7.8 years. In addition, Anderson et al⁵ reported that none of their 20 patients with total congenital dislocation or severe congenital dysplasia needed revision or showed loosening or migration of a hemispherical porous acetabular component (40–48 mm in outer diameter) after an average follow-up period of 83 months.

From analysis of the 16 retrieved cups, the main cause of early cup migration in our series was failure of osteointegration due to the sandblasted outer surface of the Wagner standard cup. It was also considered to be related to the existence of a gap between the metal cup and the subchondral bone of the acetabulum caused by screw holes projecting from the cup, especially when the residual subchondral bone was limited and the cortex was partially exposed after deep acetabular reaming to achieve sufficient coverage of the cup. Moreover, the pyramid-like elevations on the cup could have

been disadvantageous when the acetabular cortex was partially exposed after deep reaming for acetabular dysplasia in patients with small stature. And we also propose that when impingement occurs with the more rigid metal-on-metal articulation, repeated cyclic stress creates a load that ultimately increase the risk of migration of the metal shell.

In conclusion, we do not recommend using of the small Wagner standard cup. Aseptic loosening of 17 out of 55 components and revision of 16 components after a mean period of only 4.9 years indicate that this cup does not achieve sufficient osteointegration in patients with acetabular dysplasia and/or those with a small stature.

Conflicts of interest

All authors have none to declare.

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