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Bearing Change to Metal-On-Polyethylene for Ceramic Bearing Fracture in Total Hip Arthroplasty; Does It Work?

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ABSTRACT

We evaluated the short-term to midterm results of reoperation with bearing change to metal-on-polyethylene (MoP) after ceramic bearing fracture in ceramic-on-ceramic total hip arthroplasty. Nine third-generation ceramic bearing fractures (6 heads and 3 liners) were treated with bearing change to MoP. Mean age at reoperation was 52.7 years. Mean follow-up was 4.3 years. During follow-up, 2 of 3 liner-fractured hips and 1 of 6 head-fractured hips showed radiologic signs of metallosis and elevated serum chromium levels. Re-reoperation with bearing rechange to a ceramic head was performed for the hips with metallosis. One liner-fractured hip had periprosthetic joint infection. Dislocation occurred in 3 hips. From our experience, bearing change to MoP is not a recommended treatment option for ceramic bearing fracture in total hip arthroplasty.

A ceramic bearing fracture is one of the most serious complications in total hip arthroplasty (THA) with ceramic-on-ceramic (CoC) bearing [1]. The current consensus on reoperation after a ceramic bearing fracture includes immediate reoperation after diagnosis of the ceramic fracture and complete synovectomy during the reoperation [2-5]. However, there is controversy about the method of reoperation after a ceramic bearing fracture, including the selection of a new bearing surface or the replacement of well-fixed implants with damaged tapers [5,6].

In a ceramic bearing fracture, the cone of the stem or the inner surface of the cup may be damaged by fractured ceramic particles or direct contact [4]. Insertion of a new ceramic bearing on a damaged taper surface might increase the risk of ceramic refracture [7-9]. Hence, change of the implant is recommended regardless of firm fixation of the implant [5,7]. However, concerns remain regarding the removal and replacement of well-fixed cementless stems or cups due to technical difficulties with removing well-fixed implants, potential damage to the bone stock during removal, and longevity of the revised implant [10,11].

In contrast, by changing the bearings to metal-on-polyethylene bearings (MoP), well-fixed implants can be retained without concerns about ceramic refracture [10]. However, there is controversy regarding the results of reoperation with MoP bearings after ceramic bearing fractures [2,3]. Favorable long-term results were reported after MoP bearing replacement combined with complete synovectomy [3]. However, massive metallosis due to third body wear by remnant ceramic particles remains a concern [12]. In addition, fatal systemic complications related to cobalt or chrome intoxication by metallosis have been reported after MoP bearing replacement due to ceramic bearing fractures [13].

We retrospectively reviewed the short-term to midterm results of reoperation after ceramic head and liner fractures treated with MoP bearing replacement with a minimum follow-up period of 2 years. We evaluated the clinical and radiologic outcomes of reoperation with MoP bearings for ceramic bearing fractures, especially in terms of the occurrence of metallosis and complications, as well as the necessity for re-reoperation.

Materials and Methods

Between November 1999 and December 2013, 11 reoperations were performed for ceramic bearing fractures in our institution. During the reoperation for ceramic fracture, the type of bearing surface was determined according to the damage in the morse taper at the stem or the inner surface of the cup. When the taper at the stem was damaged significantly, a metal head was inserted. A polyethylene (PE) liner was inserted with new metal heads or in cases with significant damage to the inner surface of the cup. In a patient with ceramic liner fracture, morse taper was not damaged, but inner surface of cup was damaged. She was treated with reoperation with bearing change to ceramic-on-polyethylene (CoP) and followed up for 14 years without osteolysis, loosening, ceramic refracture, or other complications. In a patient with ceramic head fracture, morse taper showed mild damage on surface, and inner surface of cup was intact. He was treated with reoperation with bearing change to new CoC and followed up for 7.3 years without ceramic refracture or other complications. Excluding these 2 patients with new ceramic

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Table
Reoperation With Bearing Change to MoP for Ceramic Bearing Fracture.

Patient No.	Age at reoperation (y)	Sex	Etiology for THA	Company of Implant (Name of Cup/Stem)	Head (Size/Length of Neck)	Location of Fracture	From THA to Ceramic Fracture (y)	Event	Duration of Symptom	Type of Reoperation	New Cup or Liner of Reoperation	Follow-Up (y)	Results (Cause)	Re-Reoperation
1	54.5	Male	ONFH	Aesculap (Plasma/BiContact)	28/S	Head	3.4	DAL	6 d	MoP change	PE	2.7	Death (leukemia)	
2	36.9	Male	ONFH	Aesculap (Plasma/BiContact)	28/S	Head	4.2	TA[c]	1 d	MoP change	PE	3.6	Death (unknown)	
3	67.2	Male	ONFH	Aesculap (Plasma/BiContact)	28/S	Head	14.3	No	4 d	MoP change	PE	2.0	No complication	
4	47.2	Female	ONFH	Aesculap (Plasma/BiContact)	28/S	Head	10.1	Slip down[c]	1 mo	MoP change	PE	2.4	No complication	
5	53.5	Male	ONFH	Aesculap (Plasma/BiContact)	28/S	Head	11.3	DAL	1 d	MoP change	PE	6.0	Metallosis, dislocation	CoP change[d,e]
6	22.5	Female	ONFH	DePuy (Duraloc/AML)	28/S	Head	2.9	DAL	1 d	MoP change	PE	6.4	Recurrent dislocation	Closed reduction
7	65.1	Female	FNF	Lima (SPH/C2)[a]	28/M	Liner	6.4	No	7 mo	Cup + MoP change	Zimmer Trilogy cup + X-PE	4.8	Recurrent periprosthetic joint infection	Repeated debridement
8	70.7	Male	DA	Osteonics (Secur-fit/Accolade)	32/S	Liner	7.3	No	5 mo	MoP change[d]	X-PE	3.9	Metallosis, dislocation	CoP change[d]
9	56.8	Female	FNF	Zimmer (Trilogy/Versys)[b]	28/M	Liner	2.0	DAL	10 d	Cup + MoP change	Zimmer Trilogy cup + X-PE	7.3	Metallosis	CoC change

Abbreviations: ONFH, osteonecrosis of femoral head; FNF, femoral neck fracture; DA, degenerative arthritis; S, short; M, medium; DAL, daily activity of living; TA, traffic accident; X-PE, highly cross-linked polyethylene.
[a] Sandwich-type liner.
[b] Cemented stem.
[c] Accompanied with posterior hip dislocation.
[d] Cemented liner fixation.
[e] Metal-sleeved ceramic head.

heads, 9 reoperations in 9 patients for 6 ceramic head fractures and 3 ceramic liner fractures were included in the present study.

During follow-up, 2 patients died. One patient died due to leukemia. The cause of death for the other patient is unknown because contact with his family was lost. Follow-up for the 2 patients lasted for 2.7 and 3.6 years after reoperation, respectively, and they are included in the present study. The mean age at reoperation for all patients was 52.7 $\pm$ 15.4 years (22.5-70.7 years), with 5 male and 4 female patients.

Primary THA was performed at the mean age of 45.8 $\pm$ 21.9 years (19.6-63.4 years). Etiology of primary THA was osteonecrosis in 6 patients, femoral neck fracture in 2 patients, and degenerative arthritis in the remaining patient. In 5 hips, Plasma cups (Aesculap AG, Tuttlingen, Germany) with BiContact Stems (Aesculap AG) were implanted. The other 4 patients underwent THAs with Duraloc cup (DePuy, Leeds, UK) with AML stem (DePuy), SPH contact cup (Lima-Lto, Udine, Italy) with C2 stem (Lima-Lto), Secur-fit cup (Osteonics, Allendale, NJ) with Accolade stem (Osteonics), and Trilogy cup (Zimmer, Warsaw, IN) with Versys cemented stem (Zimmer). All ceramic heads and liners were made of third-generation alumina ceramic (Biolox Forte; CeramTec, Plochingen, Germany). There was 1 sandwich-type liner in a patient with a Lima implant. The Table shows feature of primary THA.

Ceramic fracture was diagnosed at mean 6.9 $\pm$ 4.2 years (2.0-14.3 years) after primary THA. Six heads and 3 liners were fractured (Figs. 1A and 2A). Of the 6 patients with ceramic head fracture, 2 had a history of definite trauma accompanied by posterior hip dislocation. The remaining patients with head fracture had an abrupt onset of pain with daily activities of living or without any specific prior events. With the exception of 1 patient, reoperation was performed for all patients with ceramic head fracture within 6 days after pain or discomfort developed. Diagnosis of the fracture was delayed in the last patient because she took a bed rest at home for a month after the injury. Two patients with liner fracture had periods of discomfort for more than 5 months without any prior events. The other patient with liner fracture had 10 days of discomfort, which occurred after daily activity. The mean interval between symptom onset and reoperation for ceramic fracture was 7.2 days (1 day to 1 month) with ceramic head fractures and 4.1 months (10 days to 7 months) with ceramic liner fractures. The Table also shows feature of ceramic bearing fracture.

Reoperation was planned and performed immediately after diagnosis of ceramic fracture. During reoperation, macroscopic ceramic particles were removed, and synovectomy was performed as thoroughly as possible (Fig. 1B). All stems were securely fixed, but all cones of the stems with ceramic head fractures were damaged by ceramic particles or direct contact. All stems were retained during reoperation. In 2 patients with liner fracture, the cup was removed and revised for complete removal of ceramic particles. Finally, the 28-mm metal head made of cobalt-chrome alloy and the PE liner were inserted. For all 3 liner fractures, PE liners made of highly cross-linked PE were inserted, and for all 6 head fractures, PE liners were made of conventional PE because highly cross-linked PE liners are not available for the cups. In 1 patient with ceramic liner fracture of a Secur-fit cup, a highly cross-linked PE liner was fixed with cement because no PE liner is available for the cup. The Table shows feature of reoperation for ceramic bearing fracture.

Patients were followed up at postoperative 6 weeks, 3 months, 6 months, and 1 year. After postoperative 1 year, patients were followed up annually. For clinical evaluation, the patients were asked about clinical symptoms of pain or limping. The occurrence of complications was recorded. Mean follow-up of patients was 4.3 $\pm$ 1.9 years (2.0-7.3 years).

For radiographic evaluation, standard anteroposterior radiograph and cross-table lateral radiograph were checked before and immediately after the operation and at each visit to the clinics. Using radiographs obtained at each visit to the clinic, the presence of osteolysis, loosening, or metallosis was evaluated [14-16]. We also checked serum chromium (Cr) level in patients with suspicious findings of metallosis.