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Revision of ceramic fracture with ceramic-on-polyethylene in total hip arthroplasty: Medium-term results

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ABSTRACT

There is no consensus on the bearing of choice in revision for ceramic fracture after total hip arthroplasty (THA). The aim of this study was to evaluate the outcomes using ceramic-on-polyethylene (CoP) articulation in revision for ceramic breakage. Twelve patients who underwent revision hip surgery between 2002 and 2013 were followed-up. Appropriate surgical technique, including accurate synoviectomy, was used. The cup and the head were changed in four patients and only the liner and the head were replaced in the remaining eight patients. At the final follow-up there were no cases of re-revision due to tribological reasons, and only one case of polyethylene (PE) wear and osteolysis was scheduled for a new revision because of clear cup malposition. Complications were four cases of dislocation, one case of loosening and one case of infection. Revision of fractured ceramic is a challenging situation with a high risk of early complications. Using CoP liners with accurate synoviectomy and correction of misalignment can be considered a valuable bearing option at medium-term follow-up.

Introduction

Despite the excellent results of total hip arthroplasty (THA), wear and osteolysis remain the main causes of late failure according to registry and studies data [1–4]. Specific concerns regarding the wear rates of metal-on-standard polyethylene (PE) have encouraged the manufacturers to introduce materials with high wear resistance as alternative bearing surfaces [4]. Ceramic was introduced for THA in the 1970s because of its properties of high-wear resistance and biocompatibility and it has been used for both the head and the acetabular side [5,6].

Although alumina has greatly improved the properties and mechanical resistance of ceramic, the main limitation of ceramic is still brittleness that can lead to breakage. Nowadays, the risk of fracture is extremely low, with higher risk on the liner side compared to the head [7–9]. The following have been identified as risk factors: old types of ceramics; some designs, such as skirted heads or as "sandwich" liners with the interposition of PE between ceramic and the metal back; low thickness; malposition and impingement [7,10–15].

Ceramic breakage remains a cause for concern because revision in ceramic fracture has shown poor results, largely due to third body wear caused by the presence of ceramic fragments in the articulation [7,16–19]. Moreover, there is no consensus on the bearing of choice in revision for ceramic fracture [16,18–20]. Some authors described the use of metal-on-poly (MoP), but severe complications have been reported with this type of bearing [16,18]. The presence of ceramic fragments held into the new articulation can cause third body wear of the head with catastrophic metallosis [17,19,21,22]. Ceramic-on-ceramic (CoC) has been suggested by the majority of authors and by the main manufacturer, but long-term results are lacking [20,22]. Moreover, it is preferable to avoid the same tribology that has already failed once (CoC) to prevent both the risk of new breakage and of squeaking. Ceramic-on-polyethylene (CoP) can be an alternative in which no metal is used and there are not two hard surfaces [20].

The aim of this study was to evaluate the clinical and radiological outcomes of a consecutive series of 12 patients revised with CoP for ceramic breakage.

Materials and methods

This study was a retrospective review of the outcomes of 12 consecutive patients who underwent revision hip surgery specifically for ceramic head or liner fracture at our institution between 2002 and 2013.

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Clinical data

The series comprised 12 patients (seven male, five female) (Table 1). The average age at the time of revision was 66.5 years (range 38– 76 years). The breakage occurred an average of 9.1 years (range 1.5–16 years) after the indexed surgery. The fractures occurred during normal daily activity, without a history of trauma. All the patients were operated on within 10 days after the diagnosis of breakage; six patients were recovered by the emergency unit.

All cases were CoC: 11 of the 12 patients had Biolox Forte® (CeramTec AG, Plochingen, Germany); nine of these were 28 mm heads on a "sandwich" PE-ceramic liner, and the other two were ceramic liners, one for a 32 mm head and one for a 36 mm head. The remaining patient had a Bionit® 36 mm ceramic head and liner (Mathys AG, Bettlach, Switzerland).

All the patients had been revised for liner fracture, but in two cases there was also a breakage of the head involving one 28 mm and one 32 mm head. In the patient with Bionit® ceramic, a severe wear of the head and the liner was observed with a pseudotumour.

Surgical technique and type of revision

All the patients were revised through a postero-lateral approach. Essential parts of the procedure were: a meticulous removal of all the visible ceramic fragments; aggressive debridement of the involved soft tissues; and an accurate synoviectomy with partial capsulectomy from the superior, posterior and inferior aspect of the joint, as far as was possible through a posterior incision. Repeated washings out of the joint space, of the anterior bursa and of the inferior recess were performed during and at the end of the procedure.

The femoral stem was well fixed in all the cases; minor damage of the Morse taper was found in the two cases with a fractured head (patients 4 and 12). The damage consisted of superficial scratches of the cone, so the original stem was retained.

The original socket was revised in four cases. In two cases (patients 6 and 12) there was clear X-ray evidence of loosening and migration of the cup; in both cases the original position prior to the failure was correct. In one case the cup appeared stable on X-ray but the authors suspected a lack of stability and an initial polar migration (patient 5). In the other case there was a clear malposition due to excessive inclination of 57° and anteversion of 43° (patient 2), so the cup was removed and reorientated. In the case of suspected polar migration (patient 5), the screws protruded in the socket and were damaged by the 36 mm ceramic liner. In three cases a cross-linked polyethylene (X-PE) liner was employed. In the fourth patient, who had severe Parkinson's disease, a dual-mobility bearing with ceramic head on mobile PE on ceramic liner for 40 mm heads was employed to improve stability (patient 6). This is of course a different articulation, but was included in the series as the mobile PE is articulating with ceramics, so the risks of damage by ceramic fragments could be potentially similar.

In eight hips the cup was stable and not damaged. Only the liner was revised with a new standard PE moving to a CoP couple. These were all cases of broken "sandwich" liners. The acetabular screws were removed at the time of revision in all the cases to test the stability of the cup.

Table 1
Series of 12 patients who underwent revision due to ceramic fracture.

Patient	Sex	Age at revision	Cup	Time between first implant and revision (months)	Bearing first implant	Cause of revision	Preexisting cup	Bearing of revision	Type of ceramic head	Follow-up after last revision (months)	Complication after revision
1	M	70	Press-Fit	30	CoC 28 mm Sandwich liner	Liner Fracture	Retained	CoP	Forte	156	None
2	M	68	Press-Fit	20	CoC 36 mm	Liner Fracture due to malposition of the cup	Revised	CoX-PE	Delta	50	None
3	M	74	Press-Fit + Screws	192	CoC 28 mm Sandwich liner	Liner Fracture	Retained	CoP	Delta	20	Dislocation
4	F	75	Press-Fit	186	CoC 28 mm Sandwich liner	Head + Liner Fracture	Retained	CoP	Delta	35	None
5	M	63	Press-Fit + Screws	45	CoC 36 mm	Liner Fracture + unstable cup	Revised	CoX-PE	Forte	94	None
6	F	64	Press-Fit + Screws	183	CoC 28 mm Sandwich liner	Liner Fracture + loosening of the cup	Revised	Dual Mobility CoPoC	Delta	18	None
7	F	38	Press-Fit + Screws	58	CoC 28 mm Sandwich liner	Liner Fracture	Retained	CoP	Forte	108	Wear and oesteolysis
8	F	71	Press-Fit + Screws	141	CoC 28 mm Sandwich liner	Liner Fracture	Retained	CoP	Delta	68	Dislocation
9	M	76	Press-Fit + Screws	147	CoC 28 mm Sandwich liner	Liner Fracture	Retained	CoP	Delta	62	Dislocation-Infection
10	F	72	Press-Fit	62	CoC 28 mm Sandwich liner	Liner Fracture	Retained	CoP	Forte	132	None
11	M	73	Press-Fit + Screws	98	CoC 28 mm Sandwich liner	Liner Fracture	Retained	CoP	Delta	80	Dislocation
12	M	54	Screwed Cup	156	CoC 32 mm	Head + Liner Fracture + loosening of the cup	Revised	CoX-PE	Delta	46	Cup loosening