

Case Report

Technical and Histologic Analysis of a Retrieved Carbon Fiber-Reinforced Poly-Ether-Ether-Ketone Composite Alumina-Bearing Liner 28 Months After Implantation

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Abstract: A new innovative low-wear bearing for use in total hip arthroplasty, a wear couple consisting of carbon fiber-reinforced poly-ether-ether-ketone (CF-PEEK), has been shown to be highly biocompatible and to have excellent tribological performance in the laboratory. We report the results of our technical and histologic analysis of a CF-PEEK composite acetabular cup component articulating against an alumina-head total hip arthroplasty prosthesis retrieved because of posttrauma infection from a patient in whom the components had been in place for 28 months. Histologic findings showed only a small amount of particles from the composite insert in the patient's periprosthetic tissue. Additional clinical study is necessary to estimate the relevant in vivo wear performance of CF-PEEK liners. **Key words:** total hip arthroplasty, carbon fiber, poly-ether-ether-ketone, composite acetabular component, histology.

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Wear and loosening of ultra-high-molecular-weight polyethylene acetabular components due to osteolysis are the main factors limiting the life of total hip arthroplasty (THA) prostheses [1-3]. There is currently a great deal of interest regarding the use of new composite materials for the articulating surface in THA to further improve implant survival

rates. Thus, there is a need for a low-wear bearing with the potential to provide longevity [4,5].

The most innovative solution for a soft bearing combination is a wear couple using carbon fiber-reinforced poly-ether-ether-ketone composite (CF-PEEK) as the articulation component [6]. CF-PEEK is a composite consisting of a tough polymer matrix (PEEK) and reinforcing pitch-based carbon fibers that are bonded to it. CF-PEEK has been shown to be highly biocompatible [7-9] and demonstrates excellent tribological performance in the laboratory [6].

Nevertheless, some authors have suggested that the laboratory conditions currently used to test new materials do not represent in vivo conditions [4]. Therefore, one of us (NP) participated in an international, multicenter clinical study to evaluate the safety and efficacy of a cup with a CF-PEEK

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Fig. 1. Radiograph of the right hip, taken 1 year after prosthesis implantation, shows good fixation.

insert as part of the ABG II Hip System (Stryker Orthopaedics, Mahwah, NJ).

We report here on our technical and histologic analysis of a CF-PEEK composite acetabular cup component articulating against an alumina-head total hip prosthesis retrieved from a patient in whom the components had been in place for 28 months. Revision surgery was necessitated by an infection resulting from trauma 1 year after the hip prosthesis implantation.

A definitive conclusion regarding the liner wear rate cannot be drawn from this report because it involves observation results. Only continuing clinical study can provide an estimate of the in vivo wear performance of the CF-PEEK liner.

Case Report

History

A 55-year-old man underwent primary THA because of progressive degenerative arthritis of the right hip, secondary to trauma that occurred in his 20s. The patient, 180 cm tall and weighing 95 kg at the time of the THA, had been very active.

The primary procedure was performed without cement and through a posterolateral approach, using an ABG II shell with 5 holes, 2 spikes with diameters of 7 and 52 mm, a CF-PEEK liner with PEEK locking ring, an ABG II size 4 right stem, and

a 28-4 mm alumina head (Fig. 1). There were no postoperative complications, and the patient had returned to work and leisure activity within 3 months of the index operation.

Approximately 21 months after the operation, the patient was in a car accident and underwent surgical debridement at another hospital because of a hematoma in the right thigh. By about 3 months after treatment, the patient had continuous groin pain that limited his ability to work, and a fistula became apparent. Radiographs taken at the time did not show signs of septic loosening.

The erythrocyte sedimentation rate was 55 mm/h (range for men older than 50 years, 0-20 mm/h). The C-reactive protein level was 4.5 mg/dL (normal values in our laboratory, <0.6 mg/dL). Swabs from the hip-joint sinus were collected twice during the preoperative physical examination and were placed in a sterile Petri dish and taken immediately to our hospital's microbiology laboratory. Examination there revealed the presence of *Staphylococcus capitis*.

Revision surgery with a 2-step technique was performed 26 months after the primary surgery because of the severity of the symptoms and the presence of a persistent fistula. During the revision, we observed that the CF-PEEK insert was well-secured in position in the cup with the PEEK locking ring. A portion of the rim of the cup broke away during revision. The femoral stem was well fixed in approximately 15° of anteversion and was removed. The fistula had clearly reached the cortical bone. The acetabular shell, which was in approximately 20° of anteversion, was well fixed and was removed with curved



Fig. 2. The composite liner and metal cup were firmly secured in position with the PEEK locking ring. A portion of the cup's rim was broken away during surgery.

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