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Ten- to 15-Year Clinical and Radiographic Results for a Compression Molded Monoblock Elliptical Acetabular Component

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Abstract: The aim of this study was to report the long-term results from a previously published midterm follow-up of a titanium monoblock, elliptical acetabular component. A total of 258 primary total hip arthroplasties (212 patients) with a monoblock, acetabular component were followed up for a mean period of 11.1 years (10-15). Average yearly wear rate was 0.08 mm/y (0.0009-0.32). Acetabular radiolucencies were present in 6 hips (2.4%); all were nonprogressive and present in acetabular zone I. Acetabular osteolysis was present in 5 patients (5 hips, 1.9%); all cups were stable. Four acetabular components were revised, 3 because of recurrent instability. No acetabular components were revised for polyethylene wear or dissociation, acetabular osteolysis, loosening, or deep infection. This monoblock design demonstrates excellent long-term survival and low rate of osteolysis. **Keywords:** monoblock, acetabular cup, polyethylene wear, osteolysis, backside wear.

Background

In modern primary total hip arthroplasty (THA), monoblock uncemented acetabular components have been used as an alternative to cemented polyethylene and uncemented modular acetabular implants, with or without screws for supplemental fixation, in an attempt to enhance initial fixation and reduce the rate of osteolysis [1-6]. Cemented all-polyethylene components may be technically difficult to implant and have a higher rate of loosening [7]. Concerns have been noted also with modular acetabular components. Poor locking mechanisms have been blamed for polyethylene liner dislodgement; backside wear; and, in addition, metallic debris [8-11]. Screw holes may provide a conduit for polyethylene particles and potentially lead to pelvic osteolysis [12]. Screws also produce fretting interfaces, which may increase metallic debris.

The rationale behind the design of a monoblock component focuses on the following features. The monoblock design eliminates the modularity of the metal and polyethylene. The polyethylene is compression molded into the shell, thus reducing the backside micromotion and polyethylene wear and the metallic debris from locking rings. In addition, it allows for 100% uniform support, improving contact stresses on the polyethylene, ideally leading to less wear. The monoblock cup has a hemi-ellipsoid geometry shape; its equator diameter is 2 mm larger than its polar diameter. It is inserted using the press-fit technique, allowing for a solid press fit. This technique maximizes the initial stability and fixation, and minimizes the risk for bottoming out in the bony acetabulum before a press fit is obtained on the acetabular rim. The lack of screw holes maximizes also the surface area for ongrowth and, along with solid fixation, eliminates the conduits for migration of wear particle.

Coupled with these advantages, monoblock implants introduce the potential disadvantages of the inability to see if the cup is fully seated during implantation, to easily exchange a polyethylene liner, to augment with adjoin fixation (screws) to optimize the stabilization of the component, and to modify the orientation of an elevated liner at final implantation [4].

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The senior author of this article (TPS) has used a monoblock acetabular component (Implex, Allendale, New Jersey) since 1995. This component is composed of Ti6V4Al alloy, and the beads are commercially pure titanium. The beads are between 200 and 300 mm in size; the coating consists of 3 layers of beads. The polyethylene is GUR 1020 (Perplas Medical Ltd, Lancashire, UK), packaged in a nitrogen atmosphere and gamma radiation sterilized to a nominal 30 kGy (30 Mrad). We previously described the midterm results of this acetabular component [13] that demonstrated excellent survivorship; no acetabular components were revised for polyethylene wear or dissociation, acetabular osteolysis, or loosening. Average yearly wear rate was 0.079 mm (range, 0-0.31).

The purpose of the present study was to provide a concise follow-up, at a minimum of 10 years, of this acetabular component with an emphasis on the polyethylene wear rates, rates of progressive periacetabular radiolucent lines, acetabular osteolysis, and acetabular loosening, and complications such as infection, dislocation, and heterotopic ossification.

Materials and Methods

A consecutive series of patients who presented to the senior author's offices between 1995 and 1999 for primary THA were considered eligible for the study. The following patients were excluded from the study population: patients with severe acetabular dysplasia; patients with severe bone loss on the acetabular side, requiring screws for acetabular fixation; or patients in whom the press fit was inadequate intraoperatively and the shell had to be converted to a shell with screws. Data on all patients were collected prospectively for a minimum of 10 years or until failure.

All operations were performed at a single institution (Hospital for Special Surgery) by the senior author (TPS). All patients had a 28-mm–diameter femoral head. The Implex porous-coated elliptical acetabular component was used in all patients (Fig. 1). Polyethylene thickness was at least 7 mm in all cases. Overreaming by 1 mm to the entire hemisphere of the acetabulum was performed, allowing the implant to bottom out to the acetabular floor and achieve a tight peripheral rim fit that is 1 mm underreamed to the elliptical shell rim. Most patients (95%) had cemented femoral reconstructions with either the Cobrex (Implex) or the Reality (Kinamed, Warsaw, Indiana) femoral component.

Fig. 1. Elliptical monoblock acetabular component (Implex) with cutout showing the reverse taper locking mechanism.

Postoperatively, patients had an anteroposterior radiograph of the pelvis and lateral radiograph of the affected hip performed. Patients had anteroposterior and lateral radiographs performed at their most recent follow-up. All radiographs were digitized and compared by using the Martell hip analysis software as previously outlined in the midterm results study [13]. Radiographs were examined for evidence of osteolysis or component loosening. Complications such as dislocation, infection, acetabular progressive radiolucent lines, polyethylene dislodgment, bead shedding, and heterotopic ossification were recorded.

Results

A total of 212 patients with 258 hips were available with a mean radiographic follow-up of 11.1 years (range, 10-15 years). Patient demographics and wear rates are summarized in Table 1. There were no instances of polyethylene liner dissociation and no cases of bead shedding.

Clinical Results

Although all cups in this series were implanted in the safe zone, there were 4 episodes of dislocation. Three acetabular components were revised for instability. None of these 4 patients who dislocated had any risk factor for dislocation. Two dislocations were anterior and likely due to component malposition. One of these cases was revised to a constrained component, whereas the other one had repositioning of the acetabular component. One dislocation was posterior and occurred within

Table 1. Patient Demographics and Mean Annual Wear Rate

Mean age at surgery, y (range)	61.2 (29-87)
Male:female	79:133
Mean follow-up, y (range)	11.1 (10-15)
BMI (range)	26.2 (17.7-37.7)
Diagnosis	Osteoarthritis, 200; avascular necrosis, 19; rheumatoid arthritis, 10; other, 29
Mean annual wear rate, mm/y (range)	0.08 (0.0009-0.32)