Intraocular polyimide intraocular lens haptic breakage long-term postoperatively

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We present 2 cases of 3-piece silicone intraoculanbsp;r lenses (IOLs) with broken polyimide haptics. In the first case, the IOL was implanted in the anterior chamber after posterior capsule rupture. Twelve years later, it was explanted and exchanged because of bullous keratopathy. However, on careful manipulation for explantation, the haptics shattered into multiple pieces. In the second case, initial in-the-bag implantation of the IOL was uneventful. Fifteen years later, the IOL dislocated into the anterior chamber as a result of spontaneous in situ haptic breakage. The haptics of both IOLs appeared very brittle during careful manipulation for gross and light microscopy, with further breakage. Scanning electron microscopy of both IOLs revealed no evidence of haptic degradation. Their surfaces appeared smooth and regular with jagged edges where the breaks occurred. Few studies have examined the long-term biocompatibility of polyimide, and more research is needed to determine the cause of this phenomenon.

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Intraocular lens (IOL) materials and designs used in cataract surgery have continued to evolve since the first IOL implantation performed by Sir Harold Ridley. A variety of materials has been used in the manufacture of IOL loops in multipiece-IOLs, including polyamide (nylon), polypropylene (Prolene), polyvinylidene fluoride (PVDF), poly(methyl methacrylate) (PMMA), and polyimide (Elastimide). Results of research assessing the biocompatibility of these materials has affected the use of the materials in IOL manufacture.[1] For example, it has been well-documented that nylon loops can degrade over a period of time. This degradation has contributed to nylon's lack of popularity and ultimate abandon as a haptic material in modern IOLs.[2–5]

The Staar polyimide IOL (Staar Surgical Co.) is a 3-piece silicone IOL with modified C-loop polyimide haptics with a 10-degree angulation; different models with different optic diameters and overall lengths are available. Polyimide is considered a safe material to use in implantable devices as it exhibits insignificant levels of cytotoxicity and hemolysis.[6] However, few studies have examined the long-term biocompatibility of this material, and to our knowledge, no peer-reviewed publication has addressed this issue regarding the intraocular environment. In this report, we describe 2 cases of intraocular breakage of polyimide haptics many years after IOL implantation.

CASE REPORTS

Case 1

In September of 2008, an 86-year-old man was referred to one of us (S.M.) with a history of decreased vision in his left eye. Approximately 12 years earlier, cataract surgery with implantation of a Staar 3-piece silicone posterior

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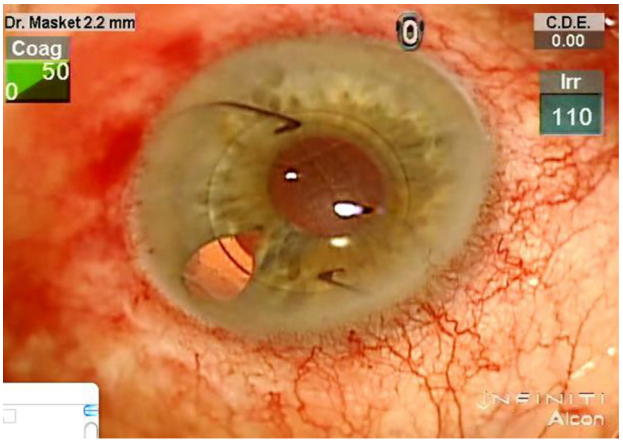
chamber IOL had been performed in that eye. The IOL was originally fixated in the anterior chamber after intraoperative posterior capsule rupture. On examination, the patient was noted to have significant pseudophakic bullous keratopathy and a large temporal iridectomy in the left eye. Vision was reduced to counting fingers. Additionally, the IOL in this eye was vaulted anteriorly within the anterior chamber (Figure 1, *A*). The IOL was eventually explanted and exchanged. During explantation, 1 haptic was noted to break into multiple pieces with only slight manipulation but all pieces were removed successfully. Examination of the right eye of the same patient showed nuclear and posterior subcapsular cataract. Cataract surgery with IOL implantation was later performed in this eye by the referring surgeon, but further information could not be obtained.



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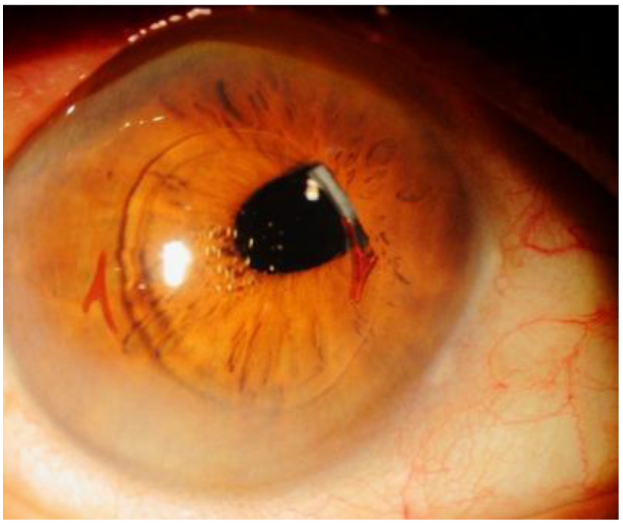

B

Figure 1. The IOLs evaluated in this study before explantation. *A*: The 3-piece silicone IOL in Case 1 can be seen in the anterior chamber through the surgical microscope. The IOL is slightly decentered. There is a large iridectomy temporally, and both haptics appear intact at this point. *B*: The IOL in Case 2 is present in the anterior chamber after spontaneous dislocation due to breakage of 1 loop (*left*). The remainder of the broken loop can be seen inserting into the optic.

Case 2

In 1998, uneventful phacoemulsification with in-the-bag implantation of a Staar 3-piece silicone IOL (model AQ2010V, serial number 2378116; +22.0 diopters) was performed in the right eye of an 80-year-old man. On February 19, 2013, the patient presented to one of us (A.C.) with complaints of decreased vision in his left eye for 7 days. Both eyes were fully dilated for complete ophthalmological examination. Fundoscopic examination revealed the presence of several hemorrhages in the optic nerve head in the left eye, and slitlamp examination revealed 3+ nuclear sclerosis. The right eye was noted to be unremarkable, with the 3-piece silicone IOL in the bag. The IOL optic showed evidence of neodymium:YAG laser pits, and a large posterior capsulotomy was noticed.

The patient returned the following day with new complaints of sudden decrease in vision in his right eye, with uncorrected distance visual acuity dropping from 20/30 to 20/50. Slitlamp examination of the right eye showed that the IOL optic was now sitting in front of the iris in the anterior chamber. The temporal IOL haptic was broken at the optic–haptic junction (Figure 1, *B*). The IOL was subsequently explanted and exchanged; however, the broken piece of the temporal haptic was left in place, as it was found to be buried within the bag.

Laboratory Analysis

Both IOLs were sent (in the dry state) to the Intermountain Ocular Research Center by the explanting surgeons. Gross and light microscopic examinations were performed with photodocumentation of the findings. Scanning electron microscopy (SEM) of the specimens was also performed. The IOLs and corresponding broken loops were air dried in an open vial, mounted on a stub with a carbon adhesive tab, and sputter-coated with a thin layer of gold. Imaging was performed at 15 and 20 kV using an S-2460N Hitachi scanning electron microscope (Hitachi, Ltd.). Gross examination of both IOLs revealed a 3-piece silicone IOL with modified C-loop polyimide copper-colored haptics. Minimal manipulation of both specimens with forceps to place them on glass slides for light microscopy caused further haptic breakage in both loops of each IOL. The loops were very brittle and appeared to have lost their elastic properties. By gross and microscopic evaluations, both IOLs appeared to have jagged breaks at the optic–haptic junction, close to the insertion points of the loops into the optic, and at other sites. Under SEM, the broken edges of the haptics of both IOLs appeared asymmetrical, with no particular pattern of breakage. Inspection of the surface of the loops in both cases revealed a smooth and regular surface, with the presence of surface deposits that appeared to correspond to protein deposits and salts. No signs of obvious degradation were found on the surface of the loops (Figures 2 and 3).

DISCUSSION

The degradation of nylon loops has been reported and discussed. Krause and Alanko[5] described a case in which the nylon loops of a Worst Medallion IOL had broken near the optic–haptic junctions, causing dislocation 5 years after implantation in a 3-year-old boy. Scanning electron microscopy showed extensive biodegradative changes in the 3 loop stumps, the