

Clinical report

Postoperative opacification of polymethylmethacrylate-intraocular lens

Onsiri Thanathanee, Tanapat Ratanapakorn, Olan Suwan-apichon

Department of Ophthalmology, Faculty of Medicine, Khon Kaen University, Khon Kaen 40002, Thailand

Background: Opacification of ophthalmic devices has been previously reported in silicone scleral buckle, Molteno implant, and intraocular lens opacification. However, there is no report on polymethyl methacrylate (PMMA) intraocular lens (IOL) calcification.

Objective: Report the clinical feature, histopathologic and spectrophotometer analysis of opacified three-piece PMMA IOL.

Method: A 60-year-old diabetic patient reported decreased visual acuity in her right eye, which had undergone phacoemulsification with PMMA IOL implantation. The ophthalmic examination revealed a white homogeneous opacification of posterior surface of the IOL. The explanted IOL was analyzed using scanning electron microscopy, energy dispersive spectroscopy, and alizarin red staining.

Results: The scanning electron microscope analysis showed granular deposits on posterior surface of the IOL. Using energy dispersive spectroscopy analysis, calcium and phosphate peaks were revealed, which was confirmed by positive for alizarin red staining.

Conclusion: This case report provided evidence of PMMA IOL calcification caused by calcium and phosphate deposits. The possible etiologies were extrinsic and/or intrinsic factors.

Keywords: Calcification, intraocular lens, polymethylmethacrylate

Opacification of ophthalmic devices has been previously reported in silicone scleral buckle [1], Molteno implant [2], and intraocular lens opacification [3-23]. Intraocular lens (IOL) opacification could affect vision and subsequent IOL exchange has been necessary in some patients. There have also been reports on opacification of various materials and types of IOLs. These include silicone IOLs (SI-30NB [3], SI-40NB [4, 5], SA-40N [6], Chiron Vision C10UB [7], AA4203 [8]), hydrophilic acrylic IOLs (Hydroview [9-12], Memory Lens [13, 14], SC 60B-OUV [15], Aqua Sense [12], BioComFold 925 [16], Stabibag [18], Bigbag [18], B-Lens [19], Centerflex

[19]), and Hydrophobic acrylic IOLs (Acrysof [20]). None has been reported on polymethyl methacrylate (PMMA) IOL calcification, only snowflake degeneration [22, 23]. We report calcification of a PMMA IOL in diabetic patient.

Case report

A 60-year-old woman with poorly controlled diabetic mellitus was referred to Srinagarind Hospital, Khon Kaen, Thailand. Regarding surgical history from her medical records, she underwent uncomplicated cataract surgery with IOL implantation in her right eye at a provincial hospital. There is no record of any viscoelastic substance used or the type of IOL inserted. In the early post-operative period, her best corrected visual acuity had improved from 3/60 to 6/36. During the follow-up period, her best-corrected visual acuity was limited to 6/36 due to macular atrophy. After one month, she complained of a decrease of vision in her right eye.

This study was presented at 22nd Asia-Pacific Association of Cataract & Refractive Surgeons (APACRS) (Tokyo, June, 2009)

Correspondence to: Olan Suwan-apichon, MD. Department of Ophthalmology, Faculty of Medicine, Khon Kaen University, Khon Kaen 40002, Thailand. E-mail: osuwanapichon@hotmail.com

At Srinagarind Hospital, we found that the best-corrected visual acuity in her right eye was 6/60. A slit-lamp examination revealed a white homogenous opacification, resembling posterior capsule opacification. The posterior segment examination revealed non-proliferative diabetic retinopathy without macular edema or asteroid hyalosis. A Nd:YAG capsulotomy was performed at once, but deposits persisted without vision improvement. Two months later, surgical capsulotomy in accordance with anterior vitrectomy and subsequent IOL exchange were performed. During the surgical procedures, the intra-operative viscoelastic substance used was IAL-F (TRB Chemedica), and the irrigating

solution was a balanced salt solution (Otsuka Pharmaceutical, Tokyo Japan) supplemented with adrenaline. The new IOL (model LC80BD, Alcon Laboratories, Texas, USA) was implanted using a transcleral-fixation technique without intraoperative complications. After operation, the best-corrected visual acuity improved to 6/36 with patient's satisfaction.

The explanted IOL was examined using a light microscope and a slit-lamp biomicroscope. We observed that the anterior surface showed no deposits, whereas the posterior surface of the optic and haptic part showed multiple gray-white granular deposits (**Fig. 1**).

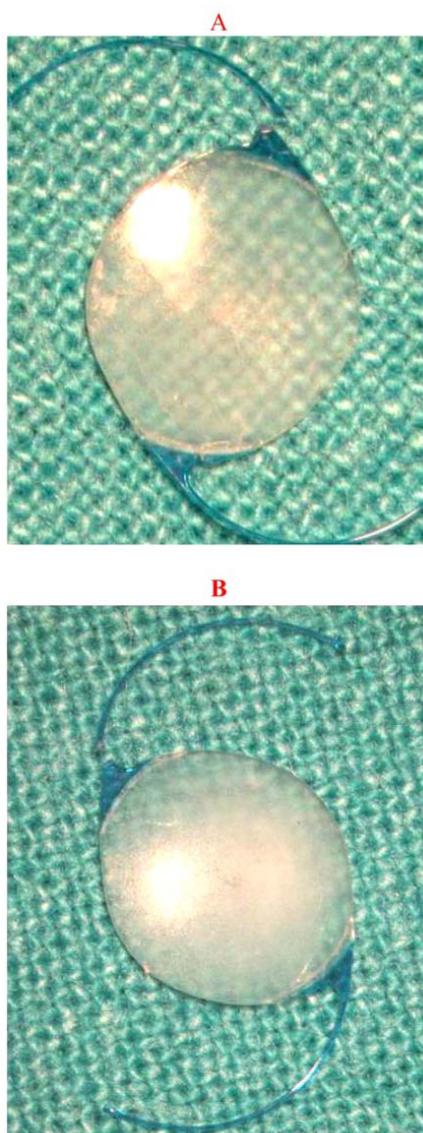


Fig. 1 Explanted IOL photographs taken under a light microscope. **A:** Photograph shows no deposits on the anterior surface. **B:** The posterior surface of the IOL is composed of multiple gray-white deposits generally distributed over the optic and haptic parts of the IOL.

Scanning electron microscope demonstrated multiple gray-white deposits on both the optic and haptic parts of the posterior surface of the IOL (**Fig. 2** and **3**).

To identify the nature of the deposits, energy dispersive radiograph spectroscopy was used. The analysis of the optic and haptic part of the IOL revealed calcium and phosphate peaks (**Fig. 4**). The

alizarin red test staining of optic part revealed reddish brown staining of the deposition, confirming calcium deposition (**Fig. 5**).

Since the material and model of the explanted IOL was unknown, it was sent to the Department of Science Service, Ministry of Science and Technology, Thailand, for analysis. It was determined that the explanted IOL was polymethylmethacrylate (PMMA).

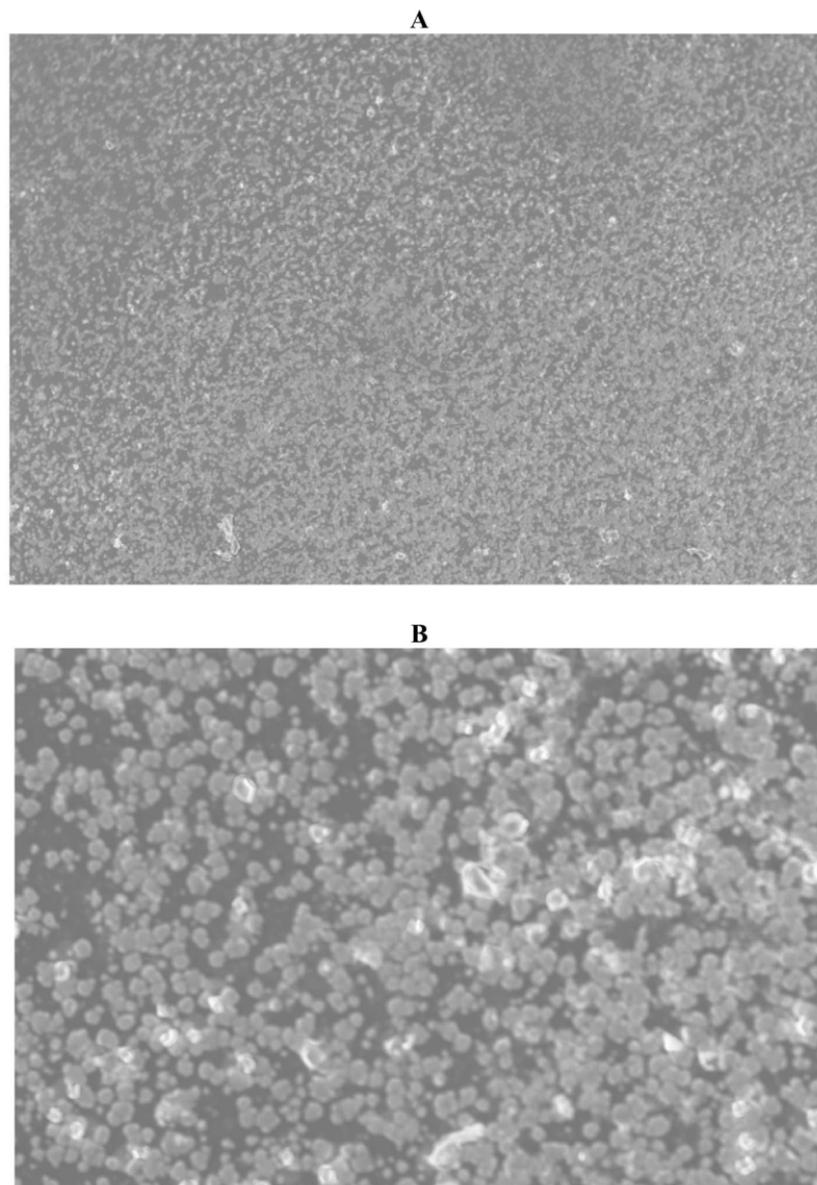


Fig. 2 Scanning electron photomicrographs from the posterior surface of the IOL's optic. **A:** Granular deposits are scattered on the optical surface (original magnification, x65). **B:** A high magnification photomicrograph shows the generalized deposits comprised two groups of distinct materials (original magnification, x250).

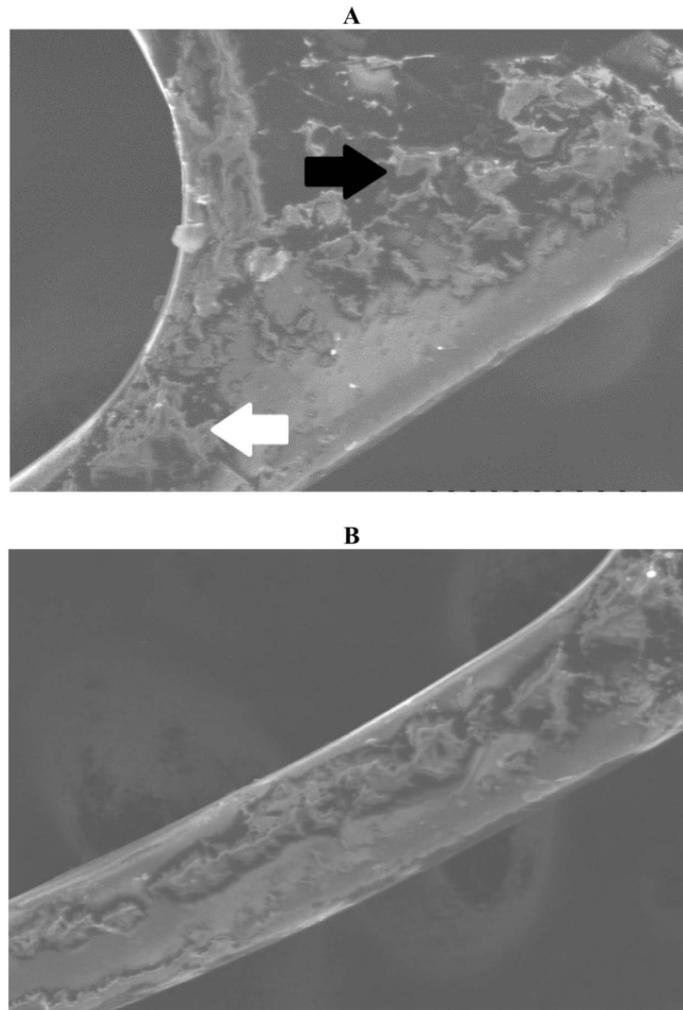


Fig. 3 Scanning electron photomicrographs of the posterior surface of the IOL's haptic. **A:** Granular deposits are distributed on the peripheral zone of the optic (dark arrow) and continued on the haptic (white arrow). **B:** The same characteristic deposits appear on the posterior surface of the haptic.

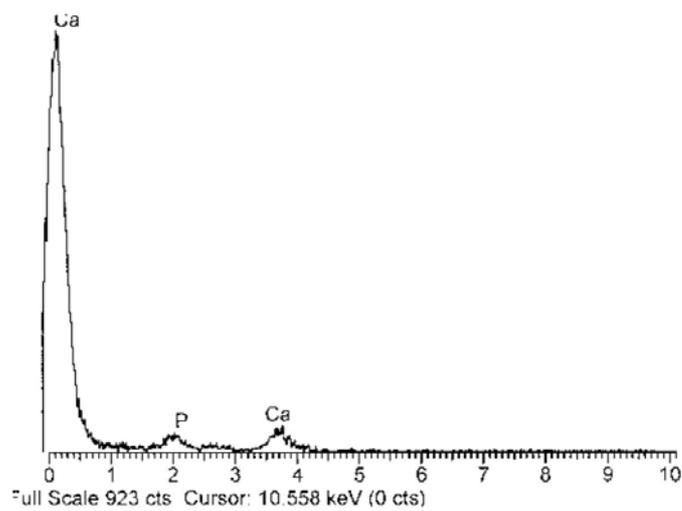


Fig. 4 Energy dispersive radiograph spectrum obtained from the posterior surface of the explanted IOL shows peaks of calcium (Ca) and phosphorus (P).

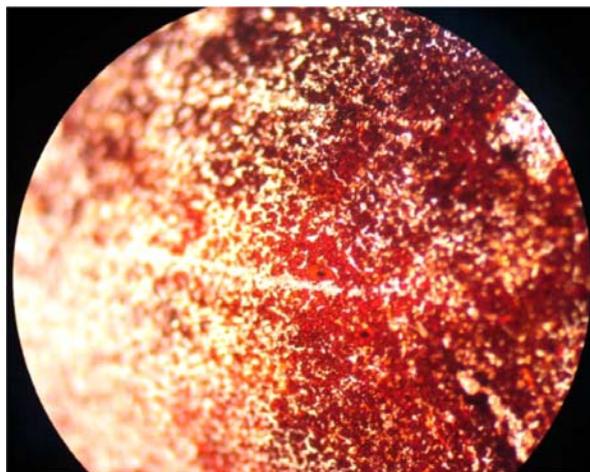


Fig. 5 Photomicrograph shows deposits from the optic part of the explanted IOL, positive for alizarin red staining.

Discussion

Calcification of intraocular lenses of various IOL materials (silicone [3, 7, 8], hydrophilic acrylic [9-16], and hydrophobic acrylic [21]) has been reported. Naganome et al. [17] reported that the incidence of hydrophilic acrylic IOL calcification was significantly higher than that of other materials. Although there appears to be a correlation between calcification and IOL material, there have been no reports on PMMA IOL calcification in diabetic patients. Most of PMMA IOL opacifications were snowflake degenerations, which revealed scattered white-brown deposits on IOL by microscopic examination. Snowflake degeneration was considered a degeneration of PMMA itself [22, 23].

The risk factors for IOL calcification are both extrinsic and intrinsic facilitating factors. The reported extrinsic factors include: post Neodymium:YAG capsulotomy [3, 8], viscoelastic substance [9, 12] (Viscoat, Alcon Laboratories and Healon GV, Phizer Global Pharmaceuticals), balance salt solution [12] (BSS or BSS Plus, Alcon Laboratories), migration of silicone from IOL packaging [11, 12], use of phosphate buffer in the polishing process [13] and premature aging of the UV absorber [14]. The reported intrinsic factors include: underlying systemic and ocular diseases such as diabetes mellitus [12, 15], asteroid hyalosis [3, 8] and glaucoma [10] and uveitis albeit [18]. The mechanisms are unclear.

The possible risk factors of PMMA IOL opacification in our case report could be post Neodymium:YAG capsulotomy and the patient's diabetic status. There could be direct contact between

the posterior IOL surface and vitreous, facilitating the passage of solutes and fatty acids from the posterior segment to the IOL surface, which might contribute to opacification. However, Sher et al. [9] showed no significant association between calcification and previous Nd:YAG capsulotomy. Moreover, analyses of aqueous humor in diabetic patients showed that the concentration of calcium and phosphate were significantly higher than in non-diabetic patients [17].

In this report, we found that calcium and phosphorus could also deposit on PMMA IOLs, which could affect visual function and require the IOL to be exchanged. To date, the exact mechanism of IOL opacification remains unclear. Careful selection of surgical ophthalmics, avoiding intraoperative complications, and controlling both systemic and ocular diseases may prevent the IOL calcification.

Acknowledgements

The authors thank Assistant Professor Mangkol Uiprasertkul for conducting the pathological examinations of the IOL, Dr. Ronakorn Panjapong for taking the photographs of the IOL, and Mr. Bryan Roderick Hamman for helping with manuscript preparation.

The authors have no conflict of interest to report.

References

1. Brockhurst RJ, Ward RC, Lou P, Ormerod D, Albert D. Dystrophic calcification of silicone scleral buckling implant materials. *Am J Ophthalmol*. 1993; 115:524-9.
2. Fellenbaum PS, Baerveldt G, Minckler DS. Calcification of a Molteno Implant. *J Glaucoma Spring*. 1994; 3:81-3.

3. Werner L, Kollarits CR, Mamalis N, Olson RJ. Surface calcification of a 3-piece silicone intraocular lens in a patient with asteroid hyalosis: a clinicopathologic case report. *Ophthalmology*. 2005; 112:447-52.
4. Hilgert CR, Hilgert A, Hofling-Lima AL, Farah ME, Werner L. Early opacification of SI-40NB silicone intraocular lenses. *J Cataract Refract Surg*. 2004; 30: 2225-9.
5. Werner L, Dornelles F, Hilgert CR, Botelho F, Conte PF, Rozot P, et al. Early opacification of silicone intraocular lenses: laboratory analyses of 6 explants. *J Cataract Refract Surg*. 2006; 32:499-509.
6. Elgohary M, Zaheer A, Werner L, Ionides A, Sheldrick J, Ahmed N. Opacification of array SA40N silicone multifocal intraocular lens. *J Cataract Refract Surg*. 2007; 33:342-47.
7. Wackernagel W, Ettinger K, Weitgasser U, Bakir BG, Schmut O, Goessler W, et al. Opacification of a silicone intraocular lens caused by calcium deposits on the optic. *J Cataract Refract Surg*. 2004; 30:517-20.
8. Foot L, Werner L, Gills JP, Shoemaker DW, Phillips PS, Mamalis N, et al. Surface calcification of silicone plate intraocular lenses in patients with Asteroid Hyalosis. *Am J Ophthalmol*. 2004; 137:979-87.
9. Sher JH, Gooi P, Dubinski W, Brownstein S, El-Defrawy S, Nash WA. Comparison of the incidence of opacification of Hydroview Hydrogel intraocular lenses with the ophthalmic viscosurgical device used during surgery. *J Cataract Refract Surg*. 2008; 34: 459-64.
10. Balasubramaniam C, Goodfellow J, Price N, Kirkpatrick N. Opacification of the Hydroview H60M intraocular lens: total patient recall. *J Cataract Refract Surg*. 2006; 32:944-8.
11. Dorey MW, Brownstein S, Hill VE, Mathew B, Botton G, Kertes PJ, et al. Proposed pathogenesis for the delayed postoperative opacification of the Hydroview Hydrogel intraocular lens. *Am J Ophthalmol*. 2003; 135:591-8.
12. Izak AM, Werner L, Pandey SK, Apple DJ. Calcification of modern foldable Hydrogel intraocular lens designs. *Eye*. 2003; 17:393-406.
13. Neuhann IM, Werner L, Izak AM, Pandey SK, Kleinmann G, Mamalis N, et al. Late postoperative opacification of a Hydrophilic Acrylic (Hydrogel) intraocular lens: a clinicopathological analysis of 106 explants. *Ophthalmology*. 2004; 111:2094-101.
14. Mattova J, Bohaeova E, Murgasova Z. Opacification of hydrophilic Memory Lens U940A intraocular lenses: analysis of 2 explanted lenses. *J Cataract Refract Surg*. 2004; 30:1934-9.
15. Pandey SK, Werner L, Apple DJ, Kaskaloglu M. Hydrophilic acrylic intraocular lens optic and haptics opacification in a diabetic patient: bilateral case report and clinicopathologic correlation. *Ophthalmology*. 2002; 109:2042-51.
16. Kleinmann G, Werner L, Kaskaloglu M, Pandey SK, Neuhann IM, Mamalis N. Postoperative opacification of the peripheral optic region and haptics of a hydrophilic acrylic intraocular lens: case report and clinicopathologic correlation. *J Cataract Refract Surg*. 2006; 32:158-61.
17. Nakanome S, Watanabe H, Tanaka K, Tochikubo T. Calcification of Hydroview H60M intraocular lenses: aqueous humor analysis and comparisons with other intraocular lens materials. *J Cataract Refract Surg*. 2008; 34:80-6.
18. Neuhann IM, Stodulka P, Werner L, Mamalis N, Pandey SK, Kleinmann G, et al. Two opacification patterns of the same hydrophilic acrylic polymer: case reports and clinicopathological correlation. *J Cataract Refract Surg*. 2006; 32:879-86.
19. Neuhann IM, Kleinmann G, Apple DJ. A new classification of calcification of intraocular lenses. *Ophthalmology*. 2008; 115:73-9.
20. Omar O, Pirayesh A, Mamalis N, Olson RJ. In vitro analysis of Acrysof intraocular lens glistenings in Acrypak and Wagon Wheel packaging. *J Cataract Refract Surg*. 1998; 24:107-13.
21. Moreno-Montanes J, Palop JA, Garcia-Gomez P, Heras H, Cristobal JA. Intraocular lens opacification after nonpenetrating glaucoma surgery with mitomycin-C. *J Cataract Refract Surg*. 2007; 33:139-41.
22. Gilmour DF, Taguri A, Bennett HG. Delayed opacification of a PMMA intraocular lens. *J Cataract Refract Surg*. 2003; 29:413-4.
23. Apple DJ, Peng Q, Arthur SN, Werner L, Merritt JH, Vargas LG, et al. Snowflake degeneration of polymethyl methacrylate posterior chamber intraocular lens optic material: a newly described clinical condition caused by unexpected late opacification of polymethyl methacrylate. *Ophthalmology*. 2002; 109:1666-75.