• Letter to the Editor •

Incomplete capsulotomy and lens fragmentation during femtosecond laser-assisted cataract surgery associated with emulsified anterior chamber silicone oil: a case report

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Dear Editor,

I am Dr. Wei Chen, from Department of Ophthalmology, Affiliated Hospital of Nantong University, Nantong, Jiangsu, China. I write to present one case report of incomplete capsulotomy and lens fragmentation during femtosecond laser-assisted cataract surgery (FLACS) associated with emulsified anterior chamber silicone oil.

Silicon oil tamponade is widely used as an effective treatment for complicated cases of ocular retinal diseases. However, silicone oils are not biodegradable and associated with several undesired complications such as silicone oil emulsification[1], cataract, glaucoma[2] and keratopathy[3]. Therefore, it is currently acknowledged that silicon oil should be evacuated as soon as a stable situation in the retina has been achieved[4], residual silicone oil droplets are not uncommon after silicone oil removal. Usually, larger amounts of silicone oil entering the anterior chamber can easily be found free to move in the anterior chamber. Sometimes, however, small emulsified silicone bubbles in the anterior chamber are not easily observed during routine slit-lamp examination.

Image-guided FLACS has become increasingly more common within the past several years. The laser can be used to perform the corneal incision, capsulotomy and lens fragmentation. Importantly, the laser pulses and the integrated OCT imaging system signal must pass through transparent media to work properly.

This study was performed according to the Helsinki Declaration and informed consent was obtained from the patient. This was a 41-year-old man who suffered from unilateral cataract in the right eye. Two years earlier, he underwent pars plana vitrectomy and silicone oil injection because of retinal detachment in the eye and underwent silicone oil removal after 6mo. Preoperatively, best corrected visual acuity (BCVA) was 1.0 logMAR OD. Intraocular pressure measured with noncontact tonometer in the right eye was 18 mm Hg. The cornea was clear, the anterior chamber was deep without visible silicone oil droplets and the lens opacity was classified grade 2 using Lens Opacities Classification System III. Results of dilated fundus examination showed the retina was normally attached. Gonioscopy was not performed at intial examination because of neglect. Intraocular lens (IOL) power calculation was obtained using the LenStar LS 900 device. Surgical options were informed, the patient elected to have FLACS instead of manual phacoemulsification.

At the time of surgery, the patient was placed supine with head and eyes in primary gaze. The eye was stabilized by docking it into the laser platform (Alcon-LenSx Inc., Aliso Viejo, CA, USA) that allows imaging of the anterior segment and precise alignment of the laser delivery system. A normal axial section image of anterior chamber was shown on the screen, but a hyperreflective line was clearly visible along the endothelium with underlying dark shadow due to no anterior segment optical coherence tomography (AS-OCT) signal penetration in retrospect (Figure 1). The attempted capsulotomy diameter was 5.2 mm using 6.0 mJ energy. Lens fragmentation was performed with an outer circular diameter of 3.6 mm and 6 radial cuts using 10 mJ of energy. Surgical procedures were performed as usual until triggered an error on display after the creation of corneal primary incision. The patient was then transferred to another operation bed to undergo phacoemulsification. Anterior chamber emulsified silicone oil droplets were observed visibly under the operating microscope (Figure 2A). Sodium hyaluronate was injected into the anterior chamber to remove the emulsified silicone oil droplets. Without silicone oil shield, incomplete capsulotomy and incomplete lens fragmentation were obvious (Figure 2B). A 1.0 mm side-port incision was created manually owing to

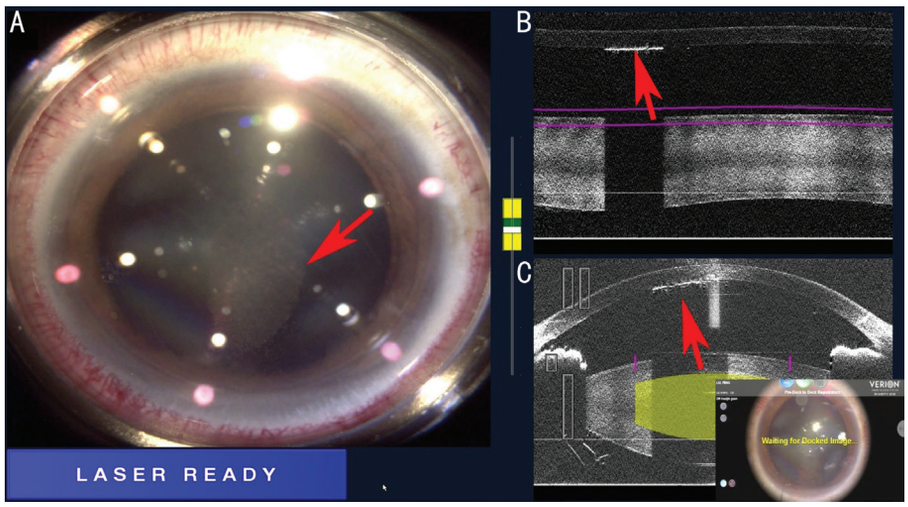

Figure 1 Intraoperative images of silicone oil droplets A: Intraoperative image showing agminated silicone oil droplets underneath the cornea (red arrow); B, C: Intraoperative sagittal AS-OCT view showing a retrocorneal line with hyperreflectivity that is concerning for the emulsified silicone oil (red arrow) and an underlying dark shadow due to the low OCT signal penetration.

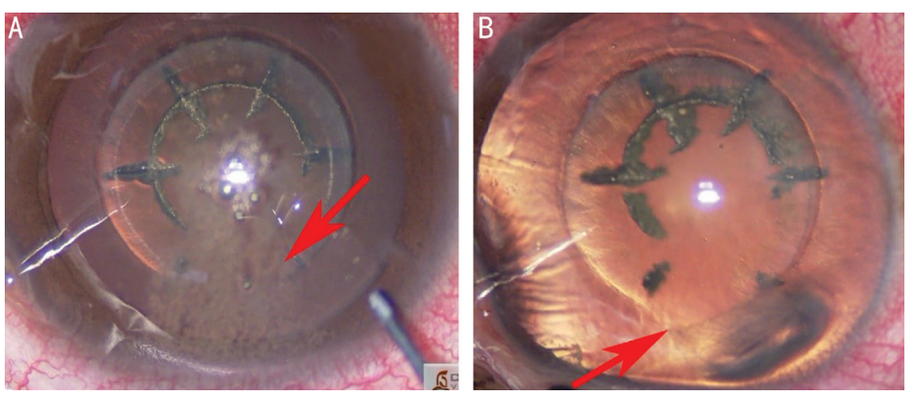

Figure 2 Incomplete capsulotomy and lens fragmentation caused by emulsified silicone oil in the anterior chamber A: Intraoperative view showing the emulsified silicone oil in the anterior chamber (red arrow). The droplets floated in the aqueous humor and moved with changes in head position. B: Intraoperative image showing an incomplete capsulotomy and lens fragmentation (red arrow) in the area beneath the silicone oil after removal of the emulsified silicone oil.

the abortion of laser delivery. The capsulotomy was completed manually without incident using a capsulorhexis forceps followed by careful hydrodissection and hydrodelineation. All nuclear fragments were removed, which was not softened and segmented in the area of silicone oil shield. Following careful removal of cortical material, an IOL was implanted in the capsular bag. No postoperative complications occurred and BCVA was 0.3 logMAR OD at 1mo after surgery.

DISCUSSION

Intraocular silicone oil is commonly used for complicated retinal detachments, trauma, and severe proliferative diabetic retinopathy[5]. The timing of emulsification is commonly based on the breakdown of the integrity of the large silicone oil bubble into smaller bubbles. Silicone oil emulsification is not an uncommon complication in long-term vitreous tamponade[6]. Several factors related to silicone oil emulsification have been discussed in earlier papers[1,7-8]. The less viscous a substance, the lower the energy that is required to disperse a large bubble of the substance into small droplets. High viscosity silicone oil is less likely to emulsify. Silicone oil viscosities now commonly used include 1000 and 5000 centistokes (cSt). While higher-viscosity silicone oils are more resistant to emulsification, it is more difficult to inject and remove them using small-gauge cannulas. Surface active agents, which can decrease the liquor surface tension, may potentially aid emulsification. Several intrinsic surfactants, such as serum, fibrin, fibrinogen, and LDLs, present at higher levels in the perioperative setting, may increase the risk of emulsification[8]. The largest factor in silicone oil emulsification, however, is attributed to the duration of tamponade. Toklu *et al*[9] reported a mean time of 13.2mo (range, 5 to 24mo) of silicone oil emulsification in a retrospective study in 32 eyes.

Silicone oil tends to emulsify over time and can migrate into various locations within the globe[10]. The droplets may migrate through broken zonules into the anterior chamber, they will hide at the superior angle, which is not easy to find by routine

slit lamp inspection. In our case, there are two reasons why emulsified silicone oil was not found in the anterior chamber during slit lamp examinations: one is that silicone oil was not too much to be visible, the other is negligence caused by opacity of the upper cornea near the corneoscleral limbus. We also need to notice that emulsified silicone oil may affect the IOL power calculations when we use A-scan ultrasound data. Hence, patients who have an ocular surgery history of silicone oil endotamponade are recommended to perform careful gonioscopy or AS-OCT of the superior angle before FLACS.

In this case, the AS-OCT images showed a hyperreflective line along the endothelium. It was approved that the hyperreflective line is the optical coherence features of intraocular silicone oil emulsification during phacoemulsification, which is in accordance with the report of Errera *et al*[11] that identical hyperreflective spherical bodies were observed in the AS-OCT after injection of emulsified silicone oil into the model rubber eyes. There was no signal reflected under the retrocorneal hyperreflective area, implying that emulsified silicone oil prevented penetration of AS-OCT signal.

Incomplete capsulotomy and incomplete lens fragmentation in this case were associated with failure of laser delivery prevented by emulsified silicone oil. Under normal circumstances, laser beams are focused onto a target through the interface between cornea and aqueous humor. When emulsified silicone oil enters the anterior chamber, the different refractive indices of the cornea, aqueous humor and emulsified silicone oil may lead to laser light scattering or a wrong laser focus. Inadequate laser energy resulted in incomplete capsulotomy and incomplete lens fragmentation.

In conclusion, thorough examination of eyes with a history of silicone oil endotamponade is necessary before FLACS including careful gonioscopy or AS-OCT imaging of the superior angle to identify the presence of emulsified silicone oil in the anterior chamber. If there is silicone oil in the anterior chamber, optical measurement of the axial eye length will be more accurate than ultrasonic examination. It is also critical to observe if there is retrocorneal hyperreflective signal in AS-OCT image before laser shot. Emulsified silicone oil in the anterior chamber may result in incomplete capsulotomy and lens fragmentation of FLACS.

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Authors' contributions: Chen W has collected data and has been involved in drafting the manuscript. Wang Y has collected data and helped revising the draft critically for important intellectual content. Wu J has made substantial contributions in analysis and interpretation of data and revising the draft critically for important intellectual content. Guan HJ contributed to data analysis and interpretation and helped revising the draft critically for important intellectual content. All the authors read and approved the final manuscript and agreed to be accountable for all aspects of the work in ensuring that questions related to accuracy or integrity of any part of the work are appropriately investigated and resolved.

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