

Flexible Iris Retractors for Management of Zonular Dialysis during Planned Phacoemulsification

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Background: The aim of this study was to determine the use of flexible iris retractors in four patients with zonular dialysis occurring during cataract surgery.

Methods: We describe the use of flexible iris retractors to stretch and fixate the capsulorhexis over the zonular dehiscence sector for patients with traumatic zonular disruption occurring during phacoemulsification, which stabilizes the capsular bag and facilitates cataract extraction without complications.

Results: Each of the four eyes was implanted with posterior chamber intraocular lens (PCIOL) successfully. The intraocular lenses (IOLs) remained well centered during the 12-month follow-up period and the patients enjoyed improved vision without complications.

Conclusion: Flexible iris retractor is a simple, convenient and useful instrument for managing zonular dehiscence that occurred during cataract extraction. It facilitates the removal of the residual lens material and IOL implantation without major complications.

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Key words: Iris retractors, zonular dialysis.

Pure zonular dialysis used to be a rare complication of cataract surgery,^(1,2) and it is generally combined with other complications. Without proper management, zonular dialysis could be the beginning of problems, which include posterior capsule rupture, posterior lens dislocation, vitreous loss, and complications of the posterior segment. Intraoperative zonular dialysis could occur in patients with pre-existing congenital and acquired zonular weakness and/or inappropriate manipulation such as inappropriate mechanical force, entrapment of the lens capsule by phacoemulsification probe. Flexible iris retractors have been reported to facilitate phacoemulsification in eyes with small pupils or known zonular weakness preoperatively.⁽³⁻⁸⁾ We describe an alternative method for managing intraoperative

zonular dialysis with iris retractors during planned phacoemulsification.

METHODS

This observational case study series was composed of four cases with incidental intra-surgical zonular dialysis during cataract surgery at Chang Gung Memorial Hospital (CGMH), Keelung, Taiwan. Characters of the four patients are showed in Table 1. None of the patients had previous ocular trauma or surgery except laser iridotomy. Neither did they show any signs of zonular weakness pre-operatively. Surgical technique is described below.

Phacoemulsification was performed using the divide and conquer technique.⁽⁹⁾ In Cases 1 to 3,

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Table 1. Characteristics and Results of Four Patients

Case/Gender/Age (years)/Eye	Past History	Time of ZD occurrence	Site of ZD (o'clock)	Pre-op BCVA	Post-op BCVA (12 months)
1/F/75/L	None	Phaco	5-7	20/200 (NC)	20/25 (-1.5/-0.5x90°)
2/F/78/L	PACG (OU) s/p LI C/D:0.5x0.5	Phaco	6-8	20/100 (+1.25/-0.75x180°)	20/50 (0/-0.75x90°)
3/F/62/L	Macular Drusen (+) PACG (OU) with glaucomatous disc (0.9x0.9) s/p LI, DM with NPDR Drusen (+)	Phaco	6-8	20/300 (+3.25/-1.75x70°)	20/70 (+0.75/-1.75x20°)
4/F/65/R	PACG (OD) with glaucomatous disc (0.9x0.9)	Nucleus splitting with pre-chopper	10-1	CF/10 cm (NC)	20/50 (-1.0/-0.75x154°)

Abbreviations: ZD: zonular dialysis; o'clock: o'clock; BCVA: best corrected visual acuity; F: female; NC: not correctable; PACG: primary angle closure glaucoma; LI: laser iridotomy; DM: diabetic mellitus; NPDR: non-proliferative diabetic retinopathy; CF: counting figure.

zonular disruption which ranged less than one quadrant occurred because the capsule was entrapped by the phacoemulsification (Phaco) probe under a high vacuum setting (170 mmHg, Alcon Universal II, Tex, USA; Fig. 1). Sufficient viscoelastic material was injected into the area of dialysis immediately to prevent further anterior vitreous prolapse. One stab incision over the peripheral cornea over the dialysis sector was made using a 27 gauge needle. A flexible iris retractor (Grieshaber, Schaffhausen, Switzerland)

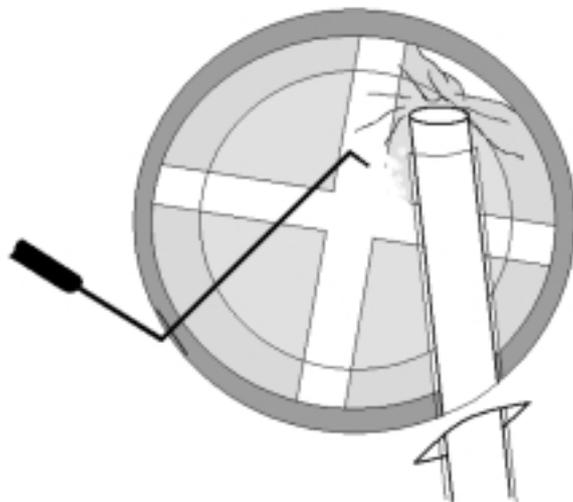


Fig. 1 The lens capsule was trapped by the Phaco probe owing to inappropriate distance between Phaco probe and lens bag.

was inserted through the stab incision, and the capsulorhexis margin was hooked and pulled peripherally to stabilize the flaccid dialyzed capsule (Fig. 2). Notably, the phacoemulsification vacuum pressure was reset to 50 mmHg and the height of the infusion bottle was lowered to reduce the anterior chamber turbulence. Residual lens material was removed cautiously using the Phaco and irrigation/aspiration (I/A) probes. Adequate viscoelastic material was injected to reform the anterior chamber and expand

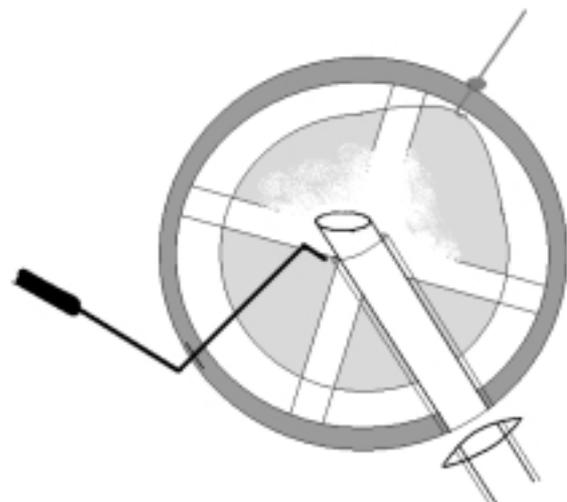


Fig. 2 The iris retractor was inserted through the corneal incision, hooked the continuous curvilinear capsulorhexis (CCC) margin and pulled capsulorhexis peripherally to stabilize the flaccid dialyzed capsule.

the partially shrunken lens bag. A large diameter posterior chamber intraocular lens (PCIOL) (720C Pharmacia & Upjohn Corp. Mich, USA) was then implanted into the lens bag and one haptic was rotated into the area of the dialysis site to expand the wrinkled lens bag in order to prevent it from interfering with post-operative vision.

In Case 4, the zonular disruption occurred while splitting the lens nucleus owing to zonular fiber stretching by the pre-chopper (Katena. NJ, USA; Fig. 3). Since the nucleus was pricked and pulled downwards and inferiorly, a lucid interval of red reflex between the lens and iris margin was noted over the counter part. Anterior vitrectomy was performed to remove the prolapsed vitreous. Because the disrupted zonular range was larger than one quadrant, two iris retractors were then used to hook the capsulorhexis margin at 2 and 10 o'clock, and the lens nucleus was extracted using a lens loop and muscle hook (Fig. 4). The residual cortex was aspirated using an I/A probe. Finally, the intraocular lens (720C. Pharmacia & Upjohn Corp.) was implanted into the bag successfully.

Case report

The technique was used in four eyes of four patients in whom preoperative slit lamp biomicroscopic assessment revealed no significant lens instability. The results are listed in Table 1. All four eyes were implanted with PCIOL successfully. The intraocular lenses (IOLs) remained well centered

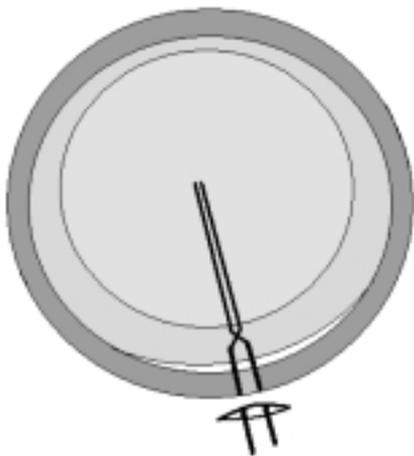


Fig. 3 Zonular dehiscence caused by the pre-chopper. The whole lens was pushed inferiorly and a lucid interval of bright red reflex was noted directly under the microscope.



Fig. 4 In Case 4, two iris retractors hook the capsulorhexis margin at 2 and 10 o'clock, and the lens were delivered with a lens loop.

during the 12-month follow-up period of and the patients enjoyed improved vision without complications. All patients had improvements in corrected and non-corrected visual acuity without significant astigmatism though glaucomatous optic nerve atrophy and macular degeneration may limit the visual function.

DISCUSSION

Sole zonular fiber dehiscence is a rare complication during cataract extraction for patients without known risk factors. Without proper management, zonular dehiscence may increase complications and unfavorable outcomes. Prompt recognition of zonular dehiscence is a priority in preventing further expansion of zonular dehiscence or capsule tear. Signs of zonular disruption include tilted or eccentric lens, phacodonesis, lucid interval of red reflex between the margin of the iris and lens, and vitreous prolapses into the anterior chamber. Most significantly, sudden deepening of the anterior chamber is frequently the first sign of zonular disruption or posterior capsular tear.

Since we used the iris retractors to manage the above complications this investigation, some essential factors should be considered. First of all, a complete smooth continuous curvilinear capsulorhexis (CCC) is necessary for such maneuvers or radial tearing of capsulorhexis might occur when CCC is stretched by iris retractors. Second, a complete hydrodissection will make sure that the rotation of the nucleus can be performed smoothly during the splitting of the nucleus. Incomplete separation of the nucleus/cortex/capsule complex ultimately expands the range of zonular dehiscence when rotating the lens.

In Cases 1 to 3, zonular dialysis occurred while Phaco was being performed. The cause of lens capsule entrapment may have been inadequate distance between the Phaco tip and lens capsule under high vacuum setting (170 mmHg). Because the dialysis site was far away from the incision wound, anterior chamber was well-stuffed with viscoelastic material and vitrectomy was not necessary among these cases. In Case 4, zonular dialysis resulted from inappropriate use of the pre-chopper (Katena, NJ, USA) as illustrated in Figure 4. Vitreous prolapse occurred and subsequent anterior chamber vitrectomy was performed. Because the location of the zonular dialysis was located just below the corneo-scleral wound, vitreous could easily prolapse through the relatively wide range of dialysis and the excision wound, the only exit of the anterior chamber. The surgical plan was transferred to ECCE and accomplished smoothly.

Eyes with primary angle-closure glaucoma may have preexisting zonular weakness due to the fluctuation of intraocular pressure and lens-iris diaphragm movement.⁽¹⁰⁾ Shallow anterior chamber depth increases the possibility of entrapment of lens capsule using the Phaco probe. The instability of the anterior chamber may also have contributed to the complications in our case, since three of four eyes in this study had primary angle-closure glaucoma. Thus, physician must keep alert when performing cataract surgery for patient with angle-closure glaucoma.

The pre-chopper is designed to split the lens nucleus without Phacoemulsification power. Several similar types of instruments have been developed, either with or without a pairing hooker. The recommended method of using this instrument is to place

the sharpest tip of the pre-chopper above the center of the nucleus, and stab down vertically, pushing deeply enough to separate the nucleus into equal pieces. Inappropriate manipulation such as pushing inferiorly (as in Case 4) will create excessive shared force on zonular fiber over the counter site and thus cause local zonular disruption.

The endocapsular ring has been used for managing zonular dialysis or weakness.⁽¹¹⁻¹⁴⁾ The rigidity of the ring, supported by the remained intact zonular fiber, provides countertraction and facilitates lens material removal and IOL implantation. In our experience, the iris retractor provided a simple, convenient and useful instrument for managing zonular dehiscence resulting from intraoperative trauma, especially for surgeons who are not familiar with endocapsular tension rings or for ophthalmic operating rooms, where endocapsular ring is not regularly employed. Novak⁽¹⁵⁾ and Lee⁽¹⁶⁾ described using iris hooks in patients with trauma-induced zonular dialysis and exfoliation-syndrome-induced lens instability, respectively. Unlike the non-fixed endocapsular tension ring, which redistributes the suspensor force to the residual capsulozonular apparatus, iris retractors provide additional suspension over the zonular dehiscence site and prevent significant anterior-posterior capsular bag movement. It stabilizes the capsular bag relative to the sclera and allows the residual lens material to be removed carefully with Phaco and I/A probe. Theoretically, iris retractors can offer a more stable hydrostatic situation in eyes with limited range of zonular rupture than the non-fixed endocapsular ring does. The modified endocapsular tension ring⁽¹⁰⁾ may provide additional support for the dehiscence site but the procedure is more complicated. For cases with extensive zonular rupture in which the capsular bag shrinks and wrinkles after removing the lens material, an endocapsular tension ring would be needed to expand and stabilize the bag to facilitate IOL implantation. If the zonular disruption is larger than the two quadrants that make the implanted PCIOL unstable, then a combination of ICCE with sclera fixed IOL or anterior chamber IOL may be more suitable. This approach is timesaving and less complicated than the procedure using iris retractors or endocapsular ring.

With rising life expectancy, lens decentration owing to irregular capsule fibrosis is expected in some cases. From our observation during the follow-

up period, pseudophacodonesis become increasingly difficult to discern in patients with partial zonular dehiscence receiving PCIOL only, particularly those resulting from intraoperative trauma without known predisposing factors for zonular weakness or disruption. This phenomenon may indicate that further adhesive or scarring processes may occur in relatively "healthy" lens capsule-zonular-ciliary complexes. However, further evidence is required to support this hypothesis.

In the four cases reported here, an alternative method of managing intra-operative zonular dialysis using iris retractors was successfully demonstrated, and acceptable preliminary results were achieved. Further follow up should focus on the lens stability and capsule contraction, which may cause eccentric displacement of the IOL in certain cases.

The flexible iris retractor is a simple, convenient and useful instrument for managing zonular dehiscence occurred during cataract extraction. It provides an additional suspensor force over the zonular dehiscence site, facilitates the removal of the residual lens material and IOL implantation without major complications.

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使用虹彩牽引鉤處理晶體乳化手術中發生之晶體韌帶斷裂

蔡振行 蕭敬熹 古婉珍

背景： 本篇文章描述使用虹彩牽引鉤處理白內障晶體乳化術中發生晶體韌帶斷裂之技巧。

方法： 在四個術中發生晶體韌帶斷裂的病患，我們使用虹彩牽引鉤，在晶體韌帶斷裂區域，勾住晶體前囊環狀撕開的邊緣，固定晶體外囊，加速手術完成。

結果： 四個眼睛均成功的完成手術並植入後房人工水晶體。在 12 個月的追蹤期間，所有的水晶體均固定良好，病患滿意術後視力且無發現任何併發症。

結論： 在處理晶體乳化術中發生晶體韌帶斷裂時，虹彩牽引鉤是簡單，方便且有效的工具，它可加速手術，安全移除剩餘的晶體並植入人工水晶體而沒有引起其他併發症。(長庚醫誌 2006;29:499-504)

關鍵字： 虹彩牽引鉤，晶體韌帶斷裂。

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