

The Result of Capsular Tension Ring Implantation during Phacoemulsification for Subluxated Lens

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Objective: To determine patient's visual acuity and complication after phacoemulsification and intraocular lens (IOL) implantation for zonular dialysis by inserting capsular tension ring (CTR) and to assess factors influencing the visual outcome.

Material and Method: In-patient and out-patient medical records of patients that underwent phacoemulsification with IOL and CTR implantations between January 1, 2004 and December 31, 2014, were reviewed for preoperative best corrected visual acuity (pre-op BCVA) and post-operative best corrected visual acuity (post-op BCVA), intraoperative and/or post-operative complications, demographic data, and degrees of zonular weakness.

Results: The present study evaluated 45 eyes from 44 patients. The mean age was 63.3 ± 12.8 years. The zonular weakness ranged from 30 to 180 degrees, the predominant weakness was 60 degrees found in 42.2%. Posterior chamber IOL was placed in the bag 97.8% and only 2.2% in the sulcus placement. The mean pre-op BCVA was 1.5 ± 1.0 logMAR. The median post-op BCVA at 1 (n = 40), 6 (n = 29), 12 (n = 21) months were 0.3 (0.2, 0.4), 0.3 (0.2, 0.4), 0.2 (0.1, 0.4) logMAR, respectively. Sixty-seven-point-five percent of the patients achieved post-op BCVA better than 0.3 logMAR at one month, 64.3% at six months, and 62.5% at one year. Corneal edema was the most common complication found in 38.7% (17/44) on the day after the operation due to the difficulty of the operation but improved with in the first week. Decentered IOL was noticed in only 2.3% (1/44). The authors could not find associated factor influencing visual outcome.

Conclusion: CTR insertion is beneficial in lens subluxation, which allowed safe phacoemulsification and successful IOL implantation. The authors had no financial or proprietary interest in the product, method, or material described herein.

Keywords: Capsular Tension Ring, Phacoemulsification, Subluxated lens, Visual outcome

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Phacoemulsification with intraocular lens insertion (PEIOL) is the safe and effective surgery nowadays, but still challenging in patients with zonular problems. In the past, ophthalmologist preferred to perform other wide incision surgical techniques. At present, intraoperative surgical instruments have been developed to stabilize capsular bag such as capsular tension rings (CTRs), modified CTRs (M-CTRs), capsular tension segments (CTSs), and iris/capsule supporting hooks that allows safe operation and preserve capsular bag for in-the-bag IOL implantation⁽¹⁻⁴⁾. Zonular weakness is the rare ophthalmic condition but influences the surgical decision making and post-operative visual outcome.

Naresuan University Hospital has long been providing phacoemulsification for cataract patients associated with zonular problems. Our research team

would like to assess the long-term result of this surgery in categorized patients and find out the factor influencing good visual outcome, which will be the guide for future surgical planning.

Material and Method

The present project was a retrospective case series study. The medical records of patients operated with PEIOL and CTR implantations by the same surgeon (Khotcharrat R) at Naresuan University Hospital between January 1, 2004 and December 31, 2014 were reviewed. The study was approved by the Institutional Review Board of Naresuan University (No. 427/57, November 2014).

The preoperative patient's characteristics were abstracted on sex, age, occupation, underlying medical diseases, laterality. The causes of zonular problem as listed on Table 1 were recorded. The preoperative and post-operative best corrected visual acuity (post-op BCVA) were converted from Snellen equivalent to logMAR⁽⁵⁾. Phacoemulsification was performed with Millennium (Bausch & Lomb Inc.). Intraoperative

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degrees of zonular weakness, type of inserted CTR and IOL, and possible complication were reviewed. Post-op BCVA at one day, one week, and one month were

recorded for short term visual acuity assessment. In addition, post-op BCVA at third month, sixth month, and one year were recorded for long-term visual acuity assessment. Post-op complications included decentered IOL, corneal edema, raised intraocular pressure, vitreous prolapse, suture abscess, retinal detachment, and decompensated phoria were also reviewed.

Table 1. Patient's baseline characteristic, causes of zonular weakness and operative procedures

Data	n (%) or mean ± SD
Sex	
Male	25 (56.8)
Age (years)	63.3±12.8
Occupations	
None	22 (48.9)
Farmer/agriculture	12 (26.7)
Engineer/technician	2 (4.4)
Officer	8 (17.8)
Health care provider	1 (2.2)
Underlying diseases	
Hypertension	23 (51.1)
Dyslipidemia	15 (33.3)
Diabetic Mellitus	10 (22.2)
Gout	2 (4.4)
CKD	1 (2.2)
Laterality	
Right	25 (55.6)
Causes of zonular weakness	
Advanced or matured cataract	11 (24.4)
Post traumatic cataract	11 (24.4)
Pseudoexfoliation syndrome	8 (17.8)
High myopia (more than -6.0 diopters)	1 (2.2)
Previous vitrectomy	0 (0)
Connective tissue diseases*	0 (0)
Idiopathic pre-op phagodonesis	2 (4.4)
None	12 (26.7)
Surgical techniques	
Phacoemulsification only	40 (88.9)
Phacoemulsification + anterior vitrectomy	4 (8.9)
Extracapsular cataract extraction	1 (2.2)
Type of CTR	
ECR	43 (95.6)
Zeiss type 3	2 (4.4)
IOL placement	
In the bag	44 (97.8)
In the sulcus	1 (2.2)
Type of IOL	
Single piece	12 (26.7)
Three pieces	33 (73.3)
Intraoperative complications	
None	28 (62.2)
PC tear	2 (4.4)
Extension of dialysis	13 (28.9)
Other	2 (4.4)

CKD = chronic kidney disease; pre-op = preoperative; CTR = capsular tension ring; IOL = intraocular lens, PC = posterior capsule
* Such as Marfan, Ehler Danlos, Weill-Marchesani syndrome

Statistical analysis

The authors used SPSS for Windows software version 17.0 for data analysis. The values of continuous variables were expressed as the mean ± standard deviation (SD). In case of non-normal distribution, continuous variables were presented as median and interquartile range and percentages. Pearson Chi-square tests at $p < 0.05$ was considered statistically significant.

Results

The present study evaluated 45 eyes from 44 patients. There were 25 men (56.8%) and 19 women (43.2%). The mean age was 63.3±12.8 years. Table 1 showed the patient's demographic data. The degrees of zonular weakness ranged from 30 to 180 degrees. The mean pre-op BCVA was 1.5±1.0 logMAR. The median post-op BCVA was 0.2 logMAR (IQR 0.1, 0.4) at one year after operation. The mean followed-up duration was 7.3±4.9 months. The median of visual improvement from each eye was 0.8 logMAR (IQR 0.4, 1.4).

From 45 successful IOL and CTR implanted eyes, 40 eyes (88.9%) had undergone solely phacoemulsification, only four eyes (8.9%) were combined anterior vitrectomy. Endo Capsular Rings™ (ECR11), Biovision Limited, were used in 43 eyes, whereas two eyes used Tensiobag®, Carl Zeiss Meditec. There were no intraoperative complications in 28 eyes (62.2%), posterior capsular tears in two eyes (4.4%), extension of dialysis in 13 eyes (28.9%) as shown in Table 1.

However, posterior chamber IOL was placed in the bag in 44 eyes (97.8%) and only one eye (2.2%) in the sulcus placement. The severity of zonular weakness was assessed at the time of operation and recorded in the operative notes and classified in a clock-hour system as shown in Fig. 1.

Preoperative phacodonesis was detected in 19 eyes (42%), thus 20 eyes (the 19th case subsequently operated alternate eye with greater care, therefore 44.4% of 45 total eyes) were planned with CTR insertion before surgery.

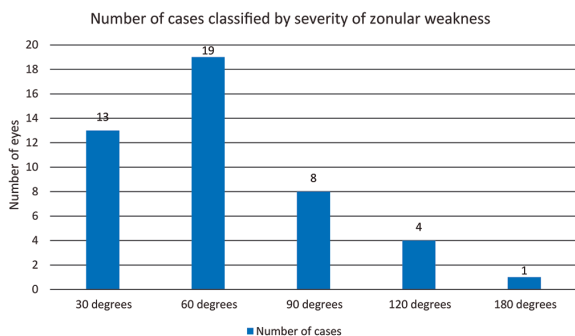


Fig. 1 Zonular weakness severity was classified in the degrees of the weakness corresponding the Clock-Hour system.

The median post-op BCVA at first day was 0.6 logMAR (0.3, 1.0), at seventh day was 0.4 logMAR (0.3, 0.6), at first month was 0.3 logMAR (0.2, 0.4), at third month was 0.3 logMAR (0.2, 0.5), at sixth month was 0.2 logMAR (0.2, 0.4), and at one year was 0.2 logMAR (0.1, 0.4).

Overall assessment of visual improvement is provided in Fig. 2. Post-operative visual acuity was obviously improved on the first day and continuously

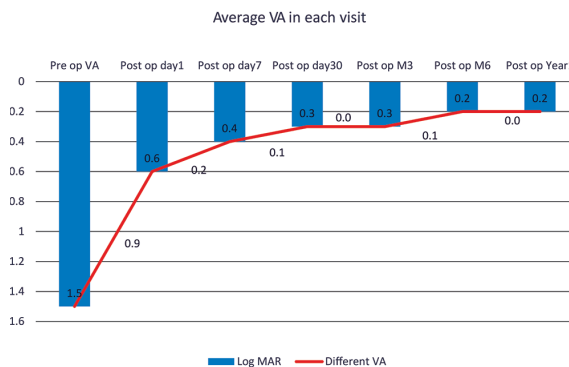


Fig. 2 The average of preoperative BCVA and post-operative BCVA in each visit.

improved in a week and at one month then stabilized until one year. No eyes had post-op BCVA worsen than pre-op BCVA. The present study found that post-op BCVA were better in 44 eyes (97.8%) and only one eye (2.2%) gained no visual improvement due to advanced pseudoexfoliation glaucoma.

According to previous studies^(9,10), the present study defined a cut-off point of BCVA less than 0.3 logMAR as good VA. Table 2 showed the percentage

Table 2. Visual outcome of cataract surgery in zonular problem at various post-operative followed-up time

	1 month (40 eyes)	3 months (33 eyes)	6 months (28 eyes)	1 year (24 eyes)
Number of good vision*, n (%)	27 (67.5)	21 (64.4)	18 (64.3)	15 (62.5)

* Best corrected visual acuity (BCVA) \leq 0.3 logMAR (20/40) or better

Table 3. Possible factors influencing visual outcome

Variables	Total number (%) (n = 45)	Total number		p-value [#]
		BCVA \leq 0.3 (n = 30)	BCVA >0.3 (n = 15)	
Sex				0.393
Male	24 (57.8)	16	10	
Female	19 (42.2)	14	5	
Underlying				0.399
HT	23 (51.1)	14	9	
No HT	22 (48.9)	16	6	
DLP	15 (33.3)	9	6	0.502
No DLP	30 (66.7)	21	9	
DM	10 (22.2)	5	5	0.205
No DM	35 (77.8)	25	10	
Ophthalmic conditions				0.086
Advanced cataract	11 (24.4)	5	6	
Not advanced	34 (75.6)	25	9	
Post trauma	11 (24.4)	7	4	0.806
No history of trauma	34 (75.6)	23	11	
PXS	8 (17.8)	5	3	0.783
No PXS	37 (82.2)	25	12	

BCVA = best corrected visual acuity; HT = hypertension; DLP = dyslipidemia; DM = diabetes mellitus; PXS = pseudoexfoliation syndrome

[#] Pearson Chi-square

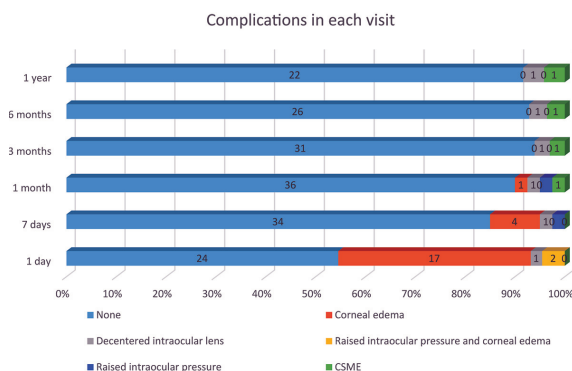


Fig. 3 Summary of post-operative complications.

of good VA in every followed-up time points. During total followed-up time, there were 66.7% (30/45) of good post-op BCVA.

All possible factors influencing visual outcome were analyzed and showed in Table 3, but the present study could not find any statistical significant associations either severity of the zonular weakness, cause of the weakness, underlying medical condition, occupation, type of IOL, or intraoperative complication.

Corneal edema was the most common complication found 38.7% (17/44) on the day after operation due to the difficulty of the operation but improved within the first week. Decentered IOL was noticed in only 2.3% (1/44). Fig. 3 showed the numbers of eyes in the percentage of complication at various post-operative followed-up time. At one year after the operation, one eye needed laser capsulotomy due to posterior capsular opacity, while 23 eyes did not need secondary intervention.

Discussion

The standard CTR is recommended for using in zonular weakness eye of less than 120 degrees (or less than 4 clock hours) or generalized mild severity⁽¹⁾. Jacob et al, reported 90.47% (19/21) success rate of combined phacoemulsification and CTR implantation for not over than 150 degrees zonular weakness eyes⁽⁶⁾ but in the present study, we had successfully operated in zonular weakness of up to 180 degrees. However, most of the included eyes in this study, 68% (31/45) were of mild severity of zonular weakness not over 60 degrees.

Tribus et al⁽⁷⁾, retrospectively reviewed 9,528 cataract surgeries in a university hospital, reported 69 eyes from 67 patients had additional CTR implantations related to advanced or matured

cataract in 40 eyes, post traumatic cataract in 23 eyes, pseudoexfoliation syndrome in four eyes and lens subluxation in two eyes. Only half of the patients (35 in 69) were preoperatively detected phacodonesis. The result from the present study confirmed the previous study^(7,8). In daily practice, ophthalmologist should keep in mind and be aware of this condition even though no phacodonesis was preoperatively detected, however the CTR should be readily available when needed. Moreover, from 66 IOL implanted eyes, 61 eyes (90%) were in the bag position. Our study gave superior result where 97.8% of cases were in the bag implantation because most of the included cases in our study had mild subluxation.

The limitations of the present study were small numbers of operated eyes because of zonular problem is a rare ophthalmic condition. This limitation is similar to other literatures that reported fewer than 50 eyes⁽⁹⁻¹¹⁾.

What is already known on this topic?

Performing cataract phacoemulsification surgery in patient with zonular weakness is a challenge. Many published articles reported on surgical techniques of CTR design, implanting techniques, and patient selection for successful surgical outcome.

What this study adds?

CTR can be used in zonular weakness up to 180 degrees and the success rate of in-the-bag-IOL implantation is high.

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Potential conflicts of interest

None.

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ผลการผ่าตัดสลายต้อกระจกและใส่เลนส์ตาเทียม ในผู้ป่วยที่มีภาวะเอ็นยึดเลนส์ไม่แข็งแรง โดยการใส่เลนส์ตาเทียมและวงแหวนเสริมความแข็งแรงของเอ็นยึดเลนส์

รสสุคนธ์ คชรัตน์, ณัฐพงษ์ เมฆาสิงห์กริชย์

วัตถุประสงค์: เพื่อค้นหาค่าระดับสายตาหลังผ่าตัดสลายต้อกระจกและใส่วงแหวนเสริมความแข็งแรงของเอ็นยึดเลนส์และใส่เลนส์ตาเทียม ในระยะยาว และประเมินปัจจัยที่อาจมีผลต่อผลลัพธ์ของการผ่าตัด รวมถึงภาวะแทรกซ้อนต่างๆ

วัสดุและวิธีการ: การศึกษาแบบย้อนหลัง โดยการทบทวนเวชระเบียนผู้ป่วยนอกและเวชระเบียนผู้ป่วยในที่ได้รับการผ่าตัด ณ โรงพยาบาล มหาวิทยาลัยนครสวรรค์ ตั้งแต่ วันที่ 1 มกราคม พ.ศ. 2547 ถึง 31 ธันวาคม พ.ศ. 2557 บันทึกข้อมูลค่าระดับสายตา ก่อนและหลังผ่าตัด เทคนิควิธีการผ่าตัด ชนิดของเลนส์และวงแหวน ระดับความรุนแรงของเอ็นยึดเลนส์ที่ไม่แข็งแรง ภาวะแทรกซ้อนขณะผ่าตัดหรือหลังผ่าตัด รวมถึงข้อมูลพื้นฐานของผู้ป่วย

ผลการศึกษา: รวบรวมข้อมูลจำนวน 45 ตา จากผู้ป่วย 44 ราย มีอายุเฉลี่ย 63.3 ± 12.8 ปี ระดับความรุนแรงของเอ็นยึดเลนส์ที่ไม่แข็งแรงตั้งแต่ 30 องศา ถึง 180 องศา โดยที่พบมากที่สุดเป็นระดับ 60 องศา จำนวน 19 ตา (42.2%) สามารถใส่เลนส์ตาเทียมในถุงหุ้มเลนส์ได้สำเร็จ 44 ตา หรือ 97.8% มีเพียง 1 ตา หรือ 2.2% เท่านั้นที่ใส่เลนส์ในบริเวณ sulcus ค่าเฉลี่ยระดับสายตาที่ดีที่สุดก่อนผ่าตัด (mean BCVA) เท่ากับ 1.5 ± 1.0 logMAR หรือ 20/400 ค่าเฉลี่ยระดับการมองเห็นหลังผ่าตัด (median post-op UCVA) ที่ 1 เดือนเท่ากับ 0.3 (0.2, 0.4) ที่ 6 เดือน เท่ากับ 0.2 (0.2, 0.4) และที่ 12 เดือน เท่ากับ 0.2 (0.1, 0.4) จากผู้ป่วยที่มาติดตามการรักษา 40, 29 และ 21 ราย ตามลำดับ มีผู้ป่วยที่สามารถมองเห็นหลังผ่าตัดดีกว่า 0.3 logMAR หรือ ดีกว่า 20/40 ณ เวลาหลังผ่าตัด 1 เดือน 67.5% หลังผ่าตัด 6 เดือน 64.3% และหลังผ่าตัด 1 ปี 62.5% ภาวะแทรกซ้อนหลังผ่าตัดที่พบมากที่สุด คือ กระจกตาบวม โดยพบ 38.7% (17 ใน 44 ตา) หลังผ่าตัด 1 วัน และเกือบทั้งหมดดีขึ้นภายใน 1 สัปดาห์ ภาวะเลนส์ตาเทียมไม่อยู่กึ่งกลางพบเพียง 2.3% (1 ใน 44 ตา) คณะผู้นิพนธ์ไม่พบปัจจัยใดมีผลต่อระดับการมองเห็น ไม่ว่าจะ เป็นระดับความรุนแรงหรือสาเหตุของเอ็นยึดเลนส์ไม่แข็งแรง โรคประจำตัว อาชีพ ชนิดของเลนส์ตาเทียมที่ใส่ หรือ ภาวะแทรกซ้อนที่เกิดขณะผ่าตัด

สรุป: การใส่วงแหวนเสริมความแข็งแรงของเอ็นยึดเลนส์ช่วยให้การผ่าตัดสลายต้อกระจกมีความปลอดภัยและเพิ่มความสำเร็จในการใส่เลนส์ตาเทียม
