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Research Article

The Modified Phaco-extra capsular extraction and implantation of lens - A descriptive study to evaluate the complications

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Abstract: Cataract is the leading cause of blindness in Sri Lanka. Lack of human resources and equipments has become a rate limiting factor cataract surgical rate (CSR). Newer techniques of phaco emulsifications are practiced by different surgeons to reduce the time per surgery. But we need to ensure the good outcomes and minimal complications with modest techniques. We wanted to evaluate the complication rates in means of Intra ocular pressure (IOP) and central corneal thickness (CCT), in relation to time and their predictors with modified Phaco-extra capsular extraction and implantation of lens (PHACO plus IOL). The method is Cohort of patient who underwent modified PHACO plus IOL were recruited from June to December 2012 from Seeduwa Wijaya Kumaratunga Hospital. Single surgeon carried out the surgery. Pre-op, after 24 hours and after 2 weeks IOP and CCT were measured by a same person. In results there were 292 patients and 118(40.4%) of them were males. Mean pre-op IOP was 14.3mmHg and it became 14.07 in day 1 and 13.9 in 2 week's time. IOP was reduced on second week. Mean pre-op CCT was 548mm and it increased to 578 in day 1 and reduced to 563 in second weeks. Patients with pre-op IOP values less than 15 mmHg had a mean IOP increase of 0.68mHg in day 1 and 0.8mmHg. Patients with pre-op IOP more than 15 mmHg had a mean reduction of 1.7mmHg in day 1 and 2.3mmHg in 2 weeks, in conclusion the difference of complications with respect to corneal thickness and IOP post operatively with modified phaco-extra capsular extraction technique is minimal. This less time consuming method may become useful in regions where the demand for cataract surgery is more than what can be offered.
Keywords: Cataract, blindness , Intra ocular pressure (IOP) , Surgery, Sri Lanka

INTRODUCTION

Cataract accounts for over 47% of blindness worldwide [1]. The prevalence of any cataract in Sri Lanka including operated eyes was 33% [2] and it was calculated as 80% among elderly[3]. Surgical removal followed by implantation of lens is the mainstay of treatment for cataract. Cataract surgery is highly a cost effective intervention because the sight is restored after a relatively low cost intervention. Cataract surgical rate (CSR) defined as the number of cataract surgeries performed per million populations per year, has significantly increased in Sri Lanka over last few years. However, in comparison to the prevalence of cataract blindness and visual impairment, it is obvious that majority of people are still without appropriate service. There are regional disparities of CSR even in a small country like Sri Lanka due to lack of infrastructure, equipment and man power [**Error! Bookmark not defined.**]. There are about 61 ophthalmologists serving in the country and vision 2020 suggested that there is a need of another 60 to provide services in the country.

There are different surgical procedures for cataract surgery. Phacoemulsification is the safest and latest with a good predictable outcome. Phacoemulsification cataract surgery is a procedure in which an ultrasonic device is used to break up and then remove a cloudy lens, or cataract, from the eye to improve vision. The insertion of an intraocular lens (IOL) usually immediately follows phacoemulsification. The efficacy, safety, and refractive errors of astigmatism after cataract surgery by phacoemulsification and manual small-incision cataract surgery techniques has been compared and studied in many instances and found the outcome is much better with the former[4]. When comparing the complication rates, visual outcome and also the rapid recovery phacoemulsification is a superior technique to other manual cataract extraction procedures. The fast restoration to daily activities is shown with phacoemulsification due to its fast visual rehabilitation[5].

Time has become the rate limiting factor when we try to increase the CSR where the conventional way of carrying out cataract surgery has a 12 step process and it takes a longer duration. The 12 steps namely,

i. Making the main incision

ii. Injection of intra camaral Xylocain
iii. Injection of visco elastic to anterior chamber
iv. Capsulorhexis
v. Hydro dissection and hydro delineation
vi. Introduction of PHACO probe into the eye through main incision
vii. Side port incision and introduction of chopper
viii. PHACO chopping and nuclear emulsification with aspiration
ix. Injection of visco elastic
x. Cortical aspiration and capsular polishing
xi. Injection of visco elastic
xii. Intra ocular lens injection

Aspiration of visco elastic Wound hydration. But some surgeons have modified the steps of the conventional standard technique to reduce the time per surgery, to lessen instrumentation and manipulation and to minimize fluid solutions used during the surgery[6].

Seeduw Wijaya Kumaratunga eye hospital is leading from the front in cataract surgical services in the country by carrying out nearly 7200 phaco emulsifications per year [7]. They carry out a modified technique of PHACO plus IOL under topical anaesthesia where the surgical time, instrumentation and liquid usage is a minimal[8,9].

Modification have been made by them in following ways

a) Performance of certain steps simultaneously (steps one and seven)
b) Omission of some standard steps (hydro dissection and hydro delineation)
c) Execution of multiple functions at the same occasion (IOL repositioning and visco elastic aspiration)
d) Multitasking of one instrument

On this basis the steps in modified surgical procedure they undertake are,

i. Main incision and side port incision
ii. Injection of visco elastic into anterior chamber with Xylocaine
iii. Capsulorhexis
iv. Introduction of PHACO probe into the eye through main incision and chopping through side port
v. PHACO chopping, nuclear emulsification, and aspiration
vi. Introduction of visco elastic
vii. Intraocular lens injection
viii. Irrigation and aspiration of lens matter and visco elastic with positioning of lens in the bag.

Hydro dissection is carried out to separate the cortex of the lens from the capsule while the hydro delineation is carried out to separate the nucleus from the cortex. Fluid is used in these procedures.

In modified method the turbulent fluid that come into the eye during PHACO emulsification, irrigation and aspiration is used for this purpose [**Error! Bookmark not defined.**].

This method has cut down a good half of the surgery duration and it has become the reason for having nearly 7200 cataract surgeries per year by a single surgeon in 2012. Therefore it can answer the problem of limited human resources and can provide cataract surgery for needy people who are waiting in lists with partial or full blindness.

But the problem arises when we go for faster technique of cataract surgery. It is weather can we keep the complication rate to a minimum with good visual outcomes that as same with old conventional technique. Therefore we planned to evaluate the complication rates of modified technique of Phacoemulsification and IOL with regard to Intra ocular pressure (IOL) changes and central corneal thickness.

Objectives

We wanted to describe the intraocular pressure changes, changes in central corneal thickness after modified extra capsular phacoemulsification.

METHODS

1.1. Patients and methods

Two hundred and ninety two patients were examined at a single ophthalmology unit (Wijaya Kumaratunga memorial eye hospital) between June to December 2012. All patients were informed as to the nature of the study and consented to undergo corneal thickness and IOP measurements serially.

Those who have any other ocular problem which may cause poor visual prognosis, patients with pseudo exfoliation, zonular dehiscence and those who have grade 1 nuclear cataract were excluded. Since the lens type has a profound effect on visual acuity, contrast and PCT, the patients who are bringing one type of lens were selected to the study. Adherence to the Declaration of Helsinki is ensured in every aspect of the study.

Study design

A descriptive cohort study was carried out. All patients underwent cataract surgery performed by the same surgeon (phacoemulsification and implantation of an intraocular lens). Measurements of the central corneal thickness were made 1 day before, 24 hours after and 2 weeks after the operation.

Pre operative and post operative corrected visual acuity, intraocular pressure and central corneal thickness were measured by a trained ophthalmic technician. Visual acuity is measured using the Snellen’s chart and applanation tonometer mounted to

slit lamp was used in intra ocular pressure measurement. Posterior capsular thickening is assessed using slit lamp in dilated pupil.

Central corneal thickness was measured with an optical low coherence reflectometer operating at a scanning speed of 0.5 m/s and a repetition rate of 15 Hz using a super luminescent diode (emission wavelength 850 nm). For each eye (n=32) the mean (SD) value of 60 consecutive scans was calculated, all measurements being made by the same person. This method has a precision of about 1 μm and a high intrasession and intersession reproducibility.

For comparative purposes the central corneal thickness was also measured by ultrasonic pachymetry (DGH 1000 Technology Inc.). For each eye the mean (SD) value of three measurements, each determined by the same person, was calculated. According to the manufacturer the precision of this method was between 5–10 μm.

Statistical analysis

Findings were described using means (Standard deviations) and percentages with 95% confidence intervals. Paired sample t-tests were carried out for comparison of IOP and CCT serially in addition to ANOVA. Pearson correlation coefficient was used to measure the correlation between pre-op and serial IOP and CCTs. Multiple logistic regression was carried out to determine the significant predictors for day 1 IOP, 2 weeks IOP, day central corneal thickness and 2 weeks central corneal thickness.

RESULTS

A total of 292 patients with cataract were included in the study. Following table describes the basic socio-demographic characteristics and vision status of participants.

Table1: Demographic characteristics and vision status of participants

Variable	Category	Male (n= 118)	%	Female (n=174)	%
Age (years)	Less than 50	14	11.86%	28	16.09%
	51-60	49	41.53%	52	29.89%
	61-70	39	33.05%	67	38.51%
	More than 70	16	13.56%	27	15.52%
Income Level (LKR)	< Rs. 10,000	52	44.83%	87	51.48%
	Rs. 10,001-20,000	43	37.07%	61	36.09%
	> Rs. 20,000	21	18.10%	21	12.43%
Visual acuity	VA >= 6/24	25	21.19%	60	34.48%
	VA < 6/24	93	78.81%	114	65.52%
Cataract Grade	1	10	8.47%	26	14.94%
	2	53	44.92%	70	40.23%
	3	44	37.29%	65	37.36%
	4	11	9.32%	13	7.47%

There were 118 (40.4%) males in the sample. Eighty eight percent of males and 84 % of females in the sample were above 51 years. Nearly 50% of the individuals had an income less than LKR. 10000. Seventy nine percent of males and 65.5% of females had a visual acuity of less than 6/24. Sixty percent of males and 47% of females had visual acuity less than 6/60. Forty six percent of males and 45% of females had a cataract grade of 3 or more severe grade.

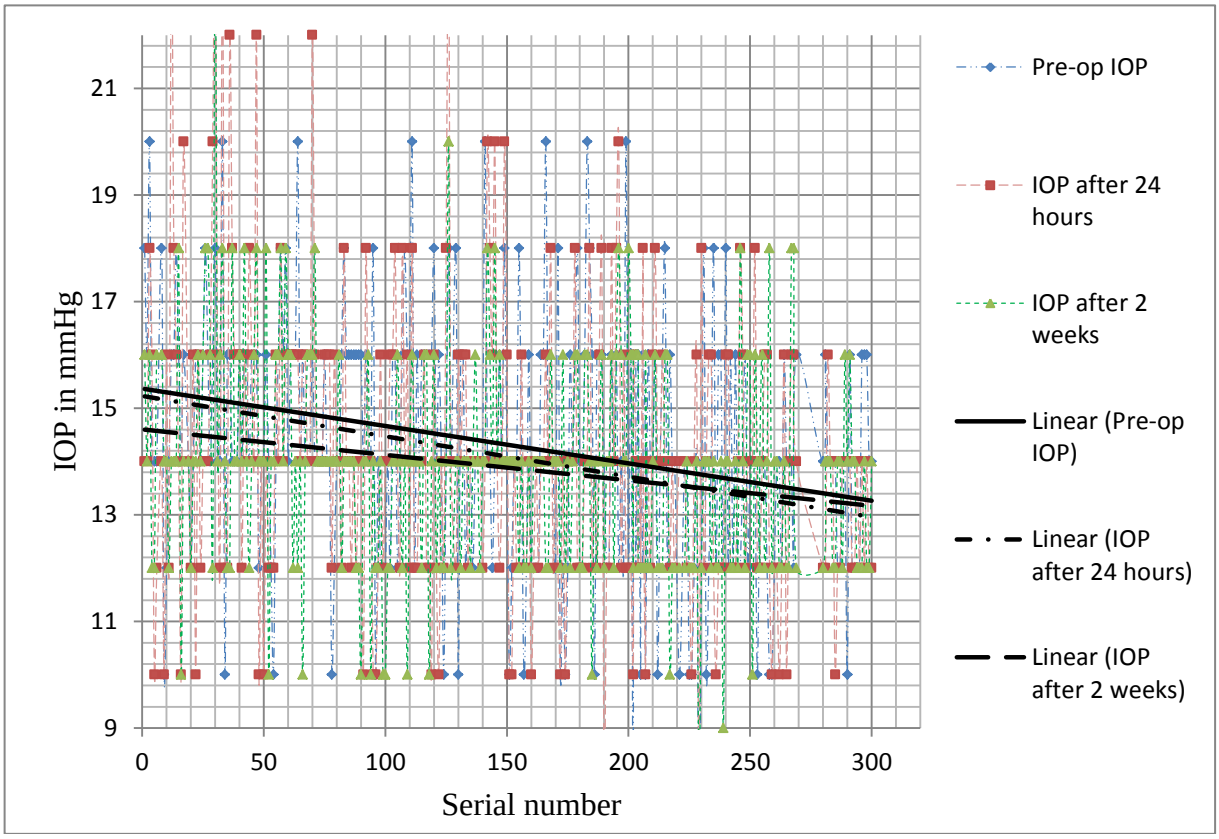
Table 2: Intra ocular pressure and central corneal thickness changes in cataract operated patients

	Mean	95% C.I.	Significance
Intra ocular pressure (mmHg)			
Pre-op	14.33	14.05-14.61	
Day 1	14.07	13.75-14.39	p=0.154
Pre-op	14.33	14.05-14.61	
2 weeks	13.89	13.65-14.13	p<0.001
ANOVA	F=1.908, df within = 873, df between = 2, p = 0.149		
Corneal thickness (mm)			
Pre-op	548.94	544.64-553.24	
Day 1	578.08	573.08-583.08	p<0.001
Pre-op	548.94	544.64-553.24	
2 Weeks	563.8	559.2-568.4	p<0.001
ANOVA	F=139.4, df within = 873, df between = 2, p<0.001		

The mean (S.D.) intraocular pressure of the sample before the surgery was 14.33 (2.3) mmHg and became 14.07 (2.8) mmHg 24 hours after surgery. Then it became 13.89 (2.1) mmHg in two weeks following the surgery. These differences did not show a statistical significance in paired sample T- test or in Analysis of Variance (Table2)

The pre-operative mean (S.D.) central corneal thickness of the sample was 548.9 (36.8) mm and it became 578.1 (42.8) mm in 24 hours. The difference was statistically significant in paired t-test (p <0.001). After 2 weeks of the surgery it was 563.8 (39.3) mm. This difference was also statistically significant in paired t-test (p <0.001). When calculated the change of central corneal thickness as a percentage it was 5.4% (4.8-6.0) in 24 hours and 2.8% (2.4-3.2%) in two weeks time (Table 2)

The IOP changes of individuals over time is shown in graph 1.



Graph 1: Intra ocular pressure changes of individuals over time.

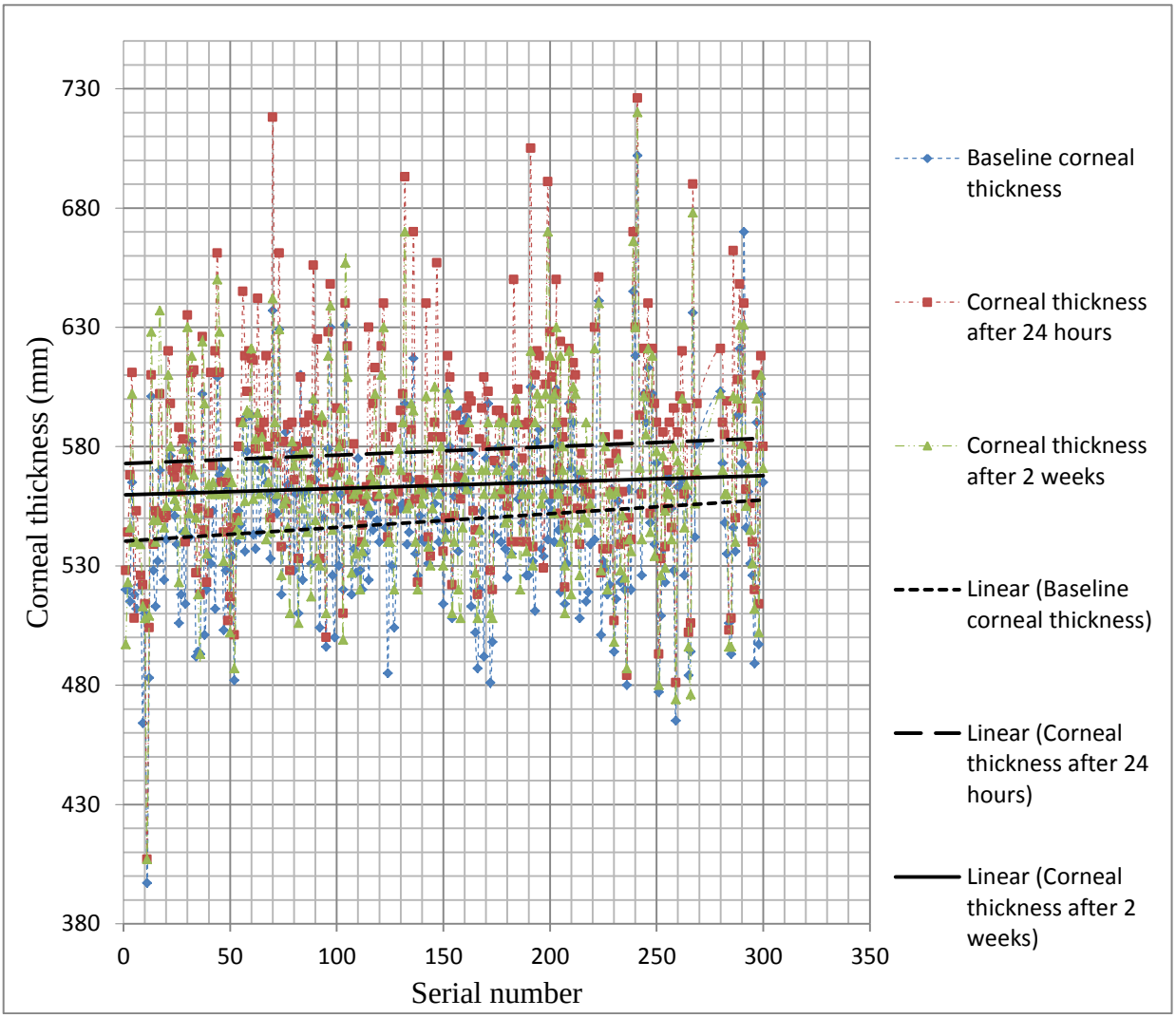
The IOP was reduced from pre-op to Day 1 and furthermore after two weeks. Patients with higher IOP had a higher reduction in 2 weeks and patients with lower IOP had lower reduction.

Table 3: Change of intra ocular pressure (IOP) according to the pre-op IOP

Pre op IOP category	**=< 15 mmHg (n=177)**			**> 15 mmHg (n=115)**		
	Mean	**SD**	**Significance**	**Mean**	**SD**	**Significance**
Day 1	0.68	2.6		-1.7	3.1	
2 weeks	0.81	2.3	< 0.001	-2.3	2.8	< 0.001

This table also shows that patients with higher pre-op IOP (> 15 mmHg) had a reduction of mean IOP nearly by 1.7mmHg in 24 hours and by 2.3 mmHg in two weeks. On the other hand patients with lower IOP (equal or less than 15mmHg) had an increase of IOP by 0.68 mmHg in 24 hours and 0.8mmHg in 2 weeks.

The changes of central corneal thickness with time are shown in graph 2.



Graph 2: The changes of central corneal corneal thickness with time.

The central corneal thickness at 24 hours was increased that from pre-op values. That value was reduced at two weeks but not reduced to that of baseline value. These were statistically significant.

Table 4: Correlation between pre-op condition and post op condition (Intra ocular pressure and central corneal thickness)

		Correlation coefficient	**Significance**
Pre -op IOP vs			
Change of IOP day 1		-0.505	<0.001
Change of IOP 2 weeks		-0.695	<0.001
Pre-op Central Corneal thickness vs			
Change of Corneal Thickness day 1		-0.109	0.063
Change of Corneal Thickness 2 weeks		-0.215	<0.001

Higher intraocular pressure is negatively correlated (-0.505) with change of IOP in day one, second week (-0.695) in Pearson correlation coefficient calculation. All these correlations were statistically significant. ($p<0.001$) (Higher reduction of IOP)

Higher central corneal thickness is negatively correlated (-0.109) with change of Day 1 ($p = 0.063$) corneal thickness and second week corneal thickness (-0.215) ($p < 0.001$).

Table 5: Predictors of day 1, 2 weeks intra ocular pressure (IOP) and central corneal thickness in multiple logistic regression analysis

Factor	IOP day1	IOP 2 weeks	Corneal thickness day1	Corneal Thickness 2 weeks
Age (years)	0.723	0.863	**0.02**	**0.02**
Sex	0.448	0.378	0.681	0.167
Cataract grade (1-4)	0.232	0.994	0.929	0.41
Pre-op corneal thickness (mm)	**0.032**	0.08	**<0.001**	**<0.001**
Duration of surgery (mins)	0.173	0.51	0.24	0.083
Hartmanns solution used (ml)	0.065	0.272	0.052	0.167
Phaco power used	0.261	0.608	0.324	0.624
Pre-op IOP (mmHg)	**<0.001**	**<0.001**	0.1	0.625

In multiple logistic regression analysis, baseline corneal thickness (p= 0.032) and baseline IOP (p <0.001) were the significant predictors for the change of IOP in day1. Baseline IOP (p <0.001) we as the significant predictor for the change of IOP in week 2, Baseline corneal thickness (p= 0.002) and baseline IOP (p <0.001) were the significant predictors for the change of IOP in week 2.

Age of the patient (p= 0.02) and baseline corneal thickness (p <0.001) were the significant predictors for the change of corneal thickness in day 1 and in week 2.

DISCUSSION

This study identified that IOP is getting reduced post operatively after modified phaco-extra capsular extraction as a whole. The mean IOP in two weeks were lower than that of 24 hours too. But these were not statistically significant at 5% level. These similar findings have been documented and described by Zamani *et al.;* [9] and Shingleton BJ *et al*.;[10] and further Poley BJ *et al.;* mentioned that cataract surgery even as a preventive and treatment modality to adult onset glaucoma[11].

Our study found that there is a negative correlation between pre operative IOP and change of IOP. That is higher the pre-op IOP, higher the reduction of IOP. Shrivastava *et al* in their review in 2010 also highlighted and described that higher reduction of IOP in patients with higher per-op IOP. They tried to explain this phenomenon partially by a statistical method called regression to the mean[12].

We also observed that patients with IOP less than 15mmHg had a post operative increase of IOP in 24 hours and in 2 weeks but patients with IOP more than 15 mmHg had a reduction of IOP. (Table 3) This increase in IOP was explained by Salvi SM *et al.;* as a result of increased corneal thickness during initial periods due to inflammation[13]. But our data did no support this explanation.

Our study found that corneal thickness also increased in 24 hours and in 2 weeks more than that of pre-operative values. Two weeks value became lower than that of 24 hours but still it was more than pre-op values. The increase of corneal thickness is due to loss or damage of endothelial cells. Salvi et al reported a 6.4% increase of IOP in day 1 but it is higher than our value of 5.4% in 24 hours [**Error! Bookmark not defined.**]. We reported a further reduction (2.8% from initial value) of IOP in 2 weeks. These values are far better than values reported by Kohlhaas M *et al.;*[14]. Some studies stated that loss or damage to endothelial cells as the rationale for corneal thickness and this is restored by 3 to 12 months [15]. Some studies found that wound healing is completed by 4 weeks thus pre-op cornel thickness is achieved by 4 weeks[16,17]. In our study we think more than 2 weeks are required to restore these corneal thicknesses to its pre-op values. Therefore the optical measurements should be delayed more than 2 weeks for wearing of spectacles.

Pre op corneal thickness and IOP were significant predictors for day 1 IOP while pre-op IOP was only significantly associated with 2 weeks IOP. Age of the patient and pre-op central corneal thickness were the predictors for day 1 and 2 weeks corneal thickness.

Finally this study highlights that there is not a huge difference of complications with respect to corneal thickness and IOP post operatively with modified phaco-extra capsular extraction technique. Therefore this less time consuming method may become a very useful in regions where the demand for cataract surgery is more than what can be offered with persistent technique of cataract surgery.

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