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The square edge IOLS lessen the need of Nd:Yag capsulotomy : A study in rural population

Shailly Raj[1], Brijesh Singh[2], Ifsa Sami [3], Sonali Singh[4]

Department of Ophthalmology, UPRIMS & RESEARCH, Saifai E,tawah 1-Senior Resident, 2-lecturer, 3& 4- Post Graduate student.

Corresponding Address: Dr. Shailly Raj, Senior Resident, Department of Ophthalmology, UPRIMS & Research, Saifai E,tawah. Email: shailly11@gmail.com

Abstract:

This is a prospective comparative interventional study performed in the patients attending in opd of ophthalmology,uprims &r,saifai over the periodof 1 year.the detailed history, general and ophthalmic examination done on 100 selected patients with different stages of cataract. Then they underwent SICS with PCIOL surgery. These patients divided into two groups the Group 'A' and Group 'B', 50 patients each. Group. A patients received round edge single piece PMMA IOL and Group B received square edge IOL. The subsequent follow up was done at first post op day, one week, one month, 3 months and 6 months. Some were followed more frequently whenever needed. At each visit record the BCVA,slit lamp examination for PCO grading , fundus examination and Nd:YAG capsulotomy done if needed. The best corrected visual acuity achieved post operatively (at 1 month) doesn't vary significantly between the two groups. 80% patients in Group A and 84% in Group B achieved BCVA of 6/9 or better. Thus, post operative vision attained is not affected by the optic edge design of the intraocular lens but at the end of one year after surgery, significant visual acuity loss was present in 16% cases of Group A and 8% cases of Group B and Clinically detectable PCO was present in 20% cases of round edged PMMA IOL group and 8% cases of square edged IOL group.Overall PCO rate was 14% while significant visual loss was seen in 12% cases. The Nd: YAG Laser capsulotomy rate doesn't correspond to the PCO rate. This implies that all cases with clinically detectable PCO may not require Nd: YAG capsulotomy.Both the rate of posterior capsule opacification and rate of Nd: YAG posterior capsulotomy is significantly lower in cases of square edged PMMA IOL as compared to that in round edged PMMA IOL.

Key words: square edge IOL, Round edge IOL, Posterior capsular opacification, Nd: YAG Capsulotomy

Introduction:

Cataract is the vision impairing disease characterized by gradual progressive opacification of the lens. Lens surgery is the most common eye surgery performed all over the world; yet cataract persists today as the most prevalent cause of preventable human blindness on earth.

During the last century, cataract surgery has revolved 360°; beginning from the sutureless couching to the much safer extracapsular cataract extraction and now again, the new age sutureless surgery – Phacoemulsification.

As Theodore rightly stated – Aphakia is the first complication of cataract extraction. The problem of image magnification, aniseikonia, spherical aberration, ring scotoma, jack in box phenomenon are well known problems with spectacle correction of aphakia. It was in the late 1940s that the tremendous optical advantages that an intraocular lens could provide were understood and acted upon by Harold Ridley[1,2] (RIDLEY H. 1951, 1952)

Today, intraocular lenses are routinely implanted throughout the world with very good clinical results. Yet, despite significant advantages in both intraocular lens design and an ever increasing sophistication in surgeon's implantation techniques, there remains the problem of body's own post-operative response to conventional intraocular lenses resulting in posterior capsule opacification (PCO). Posterior capsule opacification is the posterior migration of activated epithelial cells that leads to formation of an opaque membrane on the posterior capsule.

Posterior Capsule Opacification is the most frequent long term complication of modern cataract surgery. The interval between surgery and

opacification varies widely, with a range from three months to four years after surgery. Even today, the rate of PCO remains unacceptably high; still over 25% during 5 year post-operative follow up[3](SCHAUMBERG et.al 1998).

Posterior capsule opacification causes a decrease in visual acuity by direct blockage of the visual axis or by optical distortion. Decrease in visual acuity by more than 2 lines on Snellen's chart is considered visually significant[4](LEGLER 1993). It also causes glare and impaired contrast sensitivity function.

Intraocular Lenses: -

The modern history of intraocular lens (IOL) implantation began in 1949 with Harold Ridley in London who developed IOL made of PERSPEX (rigid polymethylmethacrylate).

The modern day intraocular lenses commonly used in SICS are posterior chamber lenses available as:-

Standard PMMA designs

- Round edged.
- Square edged.

The main treatment of PCO is Nd: YAG Laser posterior capsulotomy; a procedure which has its own risks. Vision threatening complications of Nd: YAG Laser include damage to IOL, elevation of intraocular pressure, cystoids macular oedema, IOL subluxation and exacerbation of localized endophthalmitis [5](HOLWEGER RR, 1997). PCO causes a significant financial burden to the healthcare system by cost increment for procurement of Nd: YAG Laser.

`PCO has important medical, social and economical adverse effects and consequently there is considerable interest in its prevention. As a result of clinical failure of both lens epithelial cell removal and pharmacological intervention to reduce PCO, emphasis has shifted towards IOL as a practical solution. This is why attention has been focused upon the IOL design which is the aim of this study.

Aims and Objectives

The aims of this study include:-

1) To compare the incidence of posterior capsule opacification after implantation of Square edged Polymethylmethacrylate (PMMA) and Round edged PMMA intraocular lens in cases of small incision cataract surgery.

2) To assess and quantify posterior capsule opacification in these patients based on best corrected visual acuity and slit lamp biomicroscopy grading of PCO.

3) To select clinically significant cases of PCO for Nd: YAG Laser posterior capsulotomy.

Materials and Methods

The Study was conducted on 100 eyes of 100 patients with cataract who underwent manual small incision cataract surgery with posterior chamber intraocular lens implantation in Upgraded Department of Ophthalmology,UPRIMS &R Saifai.

The patient selection was done after an informed consent and based on following eligibility criteria:

Inclusion Criteria:

1. Age 40 – 70 years.
2. Mature or immature senile cataract.
3. Nuclear sclerosis grade I, II and III.
4. Pupil should be at least 7mm dilated.

Exclusion Criteria:

1. Cataracts with causes other than age related changes.
2. Any form of corneal endothelial dystrophy or endothelial in sufficiency.
3. Active ocular inflammatory disorders. e.g.: chronic severe uveitis, vitritis.
4. Patients with past history or evidence of posterior segment pathology. e.g.: proliferative diabetic retinopathy, retinal detachment, cystoid macular oedema, optic atrophy.
5. Dense posterior subcapsular and posterior polar cataract.
6. Glaucoma patients.
7. Intraoperative complications including rent in posterior capsule, zonular dialysis and rhexis tear.
8. Pseudoexfoliation and other cases of inherent zonular weakness.
9. Patients with history of ocular trauma.

Preoperative Examination:

1. Best corrected visual acuity (BCVA).
2. Intraocular tension by Schiotz tonometer.
3. Blood pressure.
4. Type and grade of cataract.
5. Syringing of lacrimal passages.
6. Fundus examination.
7. Any significant past, family or drug history.
8. Investigations: Hb, TLC, DLC, ESR, Blood sugar (Fasting & Post-prandial).

The patients thus selected were randomly classified into two groups, comprising 50 patients each:

GROUP A: Received single piece, round edged, PMMA IOL, optic diameter 6mm & overall length 12.5mm.

GROUP B: Received single piece, square edged PMMA IOL, optic diameter and overall length.

Follow op was done on first post-operative day, first week, first month, third month, sixth month and at the end of first post operative year. At each

visit, the patient was assessed for following parameters:

1) Best Corrected Visual Acuity: Visually significant PCO is defined as decrease in best corrected post-operative visual acuity by two or more Snellen lines.

2) Slit Lamp Biomicroscopy : Using specular illumination and direct retroillumination, presence of cellular deposits on anterior surface of IOL and patterns of PCO were detected. The grading of PCO was done by grading system described SELLMAN and LINDSTROM (1988) [6]. PCO, if present, was graded from grade 1-4 accordingly.

3) Direct And Indirect Ophthalmoscopy : At each visit, fundus was examined to rule out any posterior segment complication, for example, cystoid macular oedema. If found, the patient was excluded from the study with replacement.

4) Nd :YAG Posterior Capsulotomy: The criteria for capsulotomy was loss of best corrected visual acuity by 2 or more than 2 lines on Snellen's chart with opacification significant enough. Nd: YAG capsulotomy rate was calculated for both groups at the end of one year.

At the end, all the data were compiled and statistically evaluated.

Results:

Table 1: Age Distribution

Age (years)	Groups A	Group B	Total (No.of patients)	%
40-50	6	9	15	15
51-60	24	22	46	46
61-70	20	19	39	39
Total	50	50	100	100

Table 1: Shows that maximum number of cases belonged to 51-60 years group (46%) and mean age of group A was 58.6± 12.48 years and of group B, 57.04± 14.56 years.

Table 2: Types of Cataract

S. No	Types of cataract	Groups A	Group B	Total No of patients	%
1	Nuclear	16	13	29	29
2	Nuclear + PSCC	18	22	40	40
3	Cortical	6	10	16	16
4.	PSCC	10	5	15	15
5.	Total	50	50	100	100

PSCC = posterior subcapsular cataract

Table 2: Shows the distribution of patients according to type of cataract. The nuclear with posterior sub capsular variety accounted for maximum number of cases (40%), followed by nuclear (29%), cortical (16%) and posterior sub capsular cataract (15%).

Table 3: Best Corrected Visual acuity at one month

BCVA	Group A		Group B	
	No.	%	No.	%
6/6-6/9	40	80	42	84
6/12-6/18	10	20	7	14
6/24-6/60	0	0	1	2
<6/60	0	0	0	0
Total	50		50	

Table 3: Shows best corrected visual acuity achieved one month post operatively in both groups.Visual acuity of 6/6 – 6/9 was achieved in 80% cases of groups A and 84% cases of group B. Mean BCVA does not vary significantly between the two groups.

Table 4: Visual Acuity loss from Best Corrected Visual Acuity (at one year post - operatively)

S. No.	V/A Loss	Total No. (%) of eyes	
		Group A	Group B
1.	No loss	34 (68%)	41 (82%)
2.	1 line	8 (16 %)	5 (10%)
3.	2 line	3 (6%)	3 (6%)
4.	3 lines	2 (4%)	1 (2%)
5.	4 lines	2 (4%)	0
6.	5 lines	1 (2%)	0

Table 4: Shows visual acuity loss from best corrected visual acuity (achieved after surgery) recorded at the end of one year post operatively. Significant visual loss i.e. loss of 2 or more lines was seen in 8 cases (16%) of round edged PMMA group and 4 cases (8%) of sq. edged PMMA group.

Table 5: Incidence of Posterior Capsule Opacification at various post operative visits

S. No.	Time interval from surgery	Group A (N=50)	Group B (N=50)	Total (N=100)
1.	1 month	0	0	0
2.	3 month	1	0	1
3.	6 month	7	3	10
4.	1 year	10	4	14
5.	Total	10	4	14
6.	PCO Rate	20%	8%	14%

Table 5: Shows the occurrence of PCO at various post operative visits in the 2 groups:

- There was no occurrence of PCO at 1 month.
- Only one case in group in A and none in group B had PCO at 3 months.
- At 6 months, total 7 cases in group A and 3 in group B had PCO.
- At the end of 1 year, PCO rate in group A was 20% (10 cases) and group B was 8% (4 cases).

Table 6: Grading of Posterior Capsule Opacification at one year post operatively

S. No.	Grade of PCO	Group A (N=50 %)	Group B (N=50%)	Total (N=100 %)
1.	Grade I	1 (2%)	0 (0%)	1 (1%)
2.	Grade II	5 (10%)	3 (6%)	8 (8%)
3.	Grade III	2 (4%)	1 (2%)	3 (6%)
4.	Grade IV	2 (4%)	0 (0%)	2 (4%)
5.	Total	10(20%)	4 (8%)	14(14%)

Table 6: Shows the distribution of cases of PCO in both groups according to grade of PCO seen at 1 year post operatively. Grading system described by Sellman and Lindstrom (1988) has been used for the purpose of this study. Grade I PCO is usually visually not significant while grade II may or may not hamper vision significantly.

Table 7: Requirement of Nd: YAG Posterior Capsulotomy at various post operative intervals.

S. No.	**Nd: YAG capsulotomy at interval**	**Group A (N=50 %)**	**Group B (N=50%)**	**Total**
1.	1st Month	0	0	0
2.	3rd Month	1	0	1
3.	6th Month	3	1	4
4.	1 year	4	2	6
5.	Total	8	3	11
6.	Nd: YAG Capsulotomy rate (%)	16%	6%	11%

Table 7: Shows requirement of Nd: YAG posterior capsulotomy at various time intervals after surgery.

- At 3 months, only one case in group A required Nd: YAG laser posterior capsulotomy.
- At 6th month, 3 cases from Group A and one from Group B underwent Nd: YAG laser posterior capsulotomy.
- At 1 year, 4 more cases from group A and 2 more from group B underwent the procedure.
- Overall Capsulotomy rate at the end of one year was 16% for group A and 6% for group B.

Discussion

The study included 100 eyes of 100 patients distributed randomly into 2 groups of equal size. Group A patients were implanted with round edged PMMA intra ocular lens and group B patients received square edged PMMA intra ocular lens.

The mean age of patients was 57.8± 13.6 years with a range of 40 to 70 years. The mean age for group A was 58.6± 12.48 years while that of group B was 57.04± 14.56 years. Out of the 100 patients, 58 were male and 42 female. They were randomly allotted into 2 groups. Of the 100 eyes that underwent surgery, 53 were right eyes and 47 left eyes. There was no statistically significant difference between the two groups regarding age, sex of the patients and ratio of right and left eye.

In our study, the type of cataract was classified as nuclear, nuclear with posterior subcapsular, cortical and purely posterior subcapsular. The nuclear with posterior subcapsular variety accounted for the maximum no of cases (40%) followed by nuclear (29%), cortical (16%) and posterior sub capsular (15%).The results are in accordance with those reported by SPERDUTO RD and HILLER R (1984) [7], KLEIN BE et al., (1992) [8]. The Beaver Dam Eye study, conducted over 15 years, also reported that amongst cases of age related cataracts, nuclear variety was maximum, followed by cortical and posterior sub capsular cataract (KLEIN BE et al., 2008) [9].There was no significant association found between occurrence of PCO and type of cataract.

Mean best corrected visual acuity obtained at 1 month post operatively does not vary significantly between the two groups. 80 % patients in group A and 84% in group B achieved BCVA 6/6- 6/9, 20% in group A and 14% in group B had BCVA 6/12-6/18 while only one patient (2%) in group B had BCVA 6/24-6/60. On statistical evaluation, it was found that the type of lens design doesn't affect visual acuity achieved early post operative period.AASURI M (2002) [10] reported visual acuity of 20/30 or better in both groups in his study on square versus round edged IOLs. SHAH A *et al.* (2007) [11] also reported similar post operative visual acuity with both round edged as well as square edged PMMA lenses.Visually significant PCO is defined as loss of 2 or more lines on Snellen's chart (LEGLER, 1993). On this criteria, significant vision loss at 1 year was found in 16% cases of round edged PMMA IOL (group A) while that in square edged IOL group (Group B), it was 8%.

In our study, it was found that at the end of one year, 10 cases from round edged PMMA group

and 4 cases from square edged PMMA group had clinically detectable PCO on slit lamp examination. The PCO rate for group A thus comes out to be 20% and that for group B is 8%.PCO rate in our study closely resembles that reported by RAM J *et al.* (2001)[12] . They reported PCO rate of 21.74% for round edged PMMA lenses.SHAH A *et al*. (2007) reported PCO rate of 30% in round edged and 20% in square edged PMMA IOL groups at 1 year in cases of ECCE. The increased rates can be explained by failure to achieve in-the-bag fixation in all cases of ECCE. The ratio of occurrence of PCO correlates well with our observations.

Grading of PCO at 1 year:

The grading of PCO was done on slit lamp using retroillumination and specular illumination. The grading was based on the grading system used by Sellman and Lindstrom.

In group A, one case of grade I (2%), 5 cases of grade II (10%) and 2 each of grade III and IV (4%) were seen.

Group B, there were 3 cases of grade III (6%) and one case grade III PCO (2%). No cases of grade IV PCO occurred in this group.

The occurrence of PCO depends upon both surgery related and IOL related factors. The surgery related factors include hydro dissection – enhanced cortical clean UP (VASAVADA AR *et al*., 2002) [13], in the bag fixation (RAM J *et al*., 2001) and copsulorrhexis diameter. (MEACOCK *et al*., 2001)[14]. Variation in rhexis diameter in some cases is a limiting factor in our study.

The IOL related factors include bio compatibility of IOL material (PANDEY SK *et al*., 2004) [15] and IOL design. The bio material in both groups was same i.e. poly methyl methacrylate (PMMA). Thus, the optic edge design became the main affecting factor for occurrence of PCO. The difference in PCO rates between the groups can be explained by the "no space, no cells theory" (COOMBES and SEWARD, 1999) [16]. It states that squared optic edge design provides a complete blockade of cells at optic edge preventing their migration towards centre of posterior capsule.

On statistical evaluation, the difference in PCO rate between the two groups is statistically significant ($p< 0.05$).

In the present study, the criteria for patient selection for Nd: YAG laser posterior capsulatomy was:

- 2 or more line decrease in BCVA achieved post operatively on Snellen's chart.
- Presence of pearls or fibrosis type of PCO inside IOL optic edge, reducing the red reflex.

In our study, 8 cases (16%) from the round edged PMMA IOL group and 3 cases (6%) from the square edged PMMA IOL group were taken for Nd:YAG posterior capsulotomy. Thus, the PCO rate at 1 year (14% overall) and the Nd:YAG posterior capsulotomy rate at 1 year (11% overall) are not the same according to our study. This is because patients who had <2 lines decrease in visual acuity in spite of having PCO were not subjected to laser capsulotomy.

All the eleven patients who were taken for Nd: YAG laser posterior capsulotomy showed improvement of >2 lines in their best corrected visual acuity after the procedure. The pearls at slit lamp and poor posterior pole visualization, all correlated with improvement in visual acuity after capsulotomy (ASLAM TM and PATTON N 2004)[17].

The difference in Nd:YAG capsulotomy rates between the two groups is statistically significant ($p< 0.05$). That is why use of square edge IOL is more useful in ruaral population as it decrease the need to come to hospital for visual impairment due to PCO thus maintain thee long term quality of vision.

The capsulotomy rates in our study correlate well with that of AUFFARTH GU *et al*. (2003)[18].

Conclusion

From this study, we have drawn following conclusions:

1. Mean age of patients was 57.8 ± 13.6 years with a range of 40-70 years.
2. The nuclear with posterior subcapsular type of cataract account for maximum no. of cases (40%), followed by nuclear (29%), cortical (16%) and posterior subcapsular (15%) variety.
3. The best corrected visual acuity achieved post operatively (at 1 month) doesn't vary significantly between the two groups. 80% patients in Group A and 84% in Group B achieved BCVA of 6/9 or better. 100% patients in Group A and 98% in Group B had BCVA 6/18 or better. Thus, post operative vision attained is not affected by the optic edge design of the intraocular lens.
4. At the end of one year after surgery, significant visual acuity loss was present in 16% cases of Group A and 8% cases of Group B.
5. Clinically detectable posterior capsule opacification was present in 20% cases of round edged PMMA IOL group and 8% cases of square edged PMMA IOL group at the end of one year. The difference is statistically significant.
6. Overall PCO rate was 14% while significant visual loss was seen in 12% cases. This shows that

all clinically detectable PCO may not lead to significant visual loss in all cases.
7. The Nd: YAG Laser capsulotomy rate doesn't correspond to the PCO rate. This implies that all cases with clinically detectable PCO may not require Nd: YAG capsulotomy and capsulotomy rate can't be taken as a measure of PCO rate in given population.
8. Both the rate of posterior capsule opacification and rate of Nd: YAG posterior capsulotomy is significantly lower in cases of square edged PMMA IOL as compared to that in round edged PMMA IOL.So squar dge IOL prove better solution of PCO in rural population than round edge IOL.

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