ORIGINAL ARTICLE

Contrast Sensitivity Before and After Nd:YAG Laser Capsulotomy

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Abstract

The current study was done to assess contrast sensitivity before and after Nd:YAG laser capsulotomy in the patients of posterior capsular opacification after cataract surgery. The study was conducted on 50 patients attending eye OPD, diagnosed as having posterior capsular opacification (PCO) after uncomplicated cataract surgery. Visual acuity and contrast sensitivity assessment was done, laser capsulotomy was performed and the same parameters were taken after the laser capsulotomy. In our study visual acuity improved after YAG laser capsulotomy in majority of the cases, in the range between 6/9-6/12.Before capsulotomy majority of the patients (24%) patients had mean contrast senstivity (CS) between 1.51 ±. 32log units and post capsulotomy mean CS was 1.78 ± 0.29 log units. PCO is a common longterm complication after cataract surgery with pciol implantation which causes a decrease in visual function and CS. After Nd:YAG laser capsulotomy, the CS improved significantly there by increasing visual performance and quality of vision.

Key Words

Contrast sensitivity, Posterior Capsular Opacification, N d:YAG laser capsulotomy, Pelli Robson Contrast

Introduction

Contrast describes the difference in the average luminance between two visible areas. Contrast sensitivity is the measure of ability to detect slight difference in luminance between two areas. Contrast is defined as ratio of the difference in luminance of these two adjacent areas to the lower or higher of these luminance values. The amount of contrast a person needs to see a target s called contrast threshold (1).

The ability to perceive the slight changes in luminance between regions, which are not separated by definite borders, is very important. Patients who complain of visual disturbance may be acuities of 6/6 or better. In many cases loss of contrast sensitivity is more prominent and disturbing to the patients as compared to the loss of visual acuity (2). Contrast however, measured is expressed as percentage from 0% to 100%. Contrast sensitivity has been documented as undergoing specific changes in many disorders such as media opacities, generalized retinal disorder (e.g. diabetes), localized retinal disorder (e.g. macular degeneration) and optic neuropathies (ranging from multiple sclerosis to ischemic optic neuropathy) besides posterior capsular opacification.

The most commonly used letter chart designed to assess contrast sensitivity is the Pelli-Robson chart. Glare and contrast sensitivity testing are helpful in detecting and qualifying visual problems related to after cataract (3). Assessment of contrast sensitivity is indicated for patients who have visual problems despite normal visual acuity (4). Contrast sensitivity uncovers a hidden loss of visual function, that is, it reveals the presence of visual dysfunction not apparent through other visual evaluation. It provides insight into the extent of patient's visual disability and functional performance problems. Contrast sensitivity impairment after development of posterior capsular opacification, is associated with an assortment of visual performance problems, including difficulties in

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mobility, driving, reading, face recognition and everyday tasks such as using tools and finding objects. Thus, contrast sensitivity plays a vital role in day to day life. Extra capsular cataract extraction (ECCE) with implantation of posterior chamber intraocular lens, is the most commonly performed surgery worldwide with the success rate of over 95% (5). Visually significant posterior capsular opacification is the most common late complication of uncomplicated cataract surgery, prevalence of which has been estimated at up to 50% at 5 years after surgery (6).

Patients with opacification of posterior capsule may have a relatively good visual acuity but still experience serious visual loss under bright light conditions (7). Morphological characteristics of posterior capsular opacification affect vision and contrast sensitivity, (8).

Posterior capsular opacification can affect vision directly by blocking the visual axis or indirectly either by causing traction folds in posterior capsule and decentration of intraocular lens. It can also decrease the contrast sensitivity and produce glare disability (9).

Since most frequent complication of extra capsular cataract surgery is posterior capsular opacification, the Nd : YAG laser has created immediate favourable response in ophthalmology. It creates optical breakdown with in millionths of a second and is a photo disruptive laser. Nd : YAG capsulotomy is the second most commonly performed ophthalmic surgical procedure. By the use of Nd : YAG laser capsulotomy the central part of the opacified capsule can be removed and the patients visual performance improved (10). Nd : YAG laser capsulotomy is shown to significantly improve visual acuity, contrast sensitivity (11). Since Extra capsular cataract extraction with posterior chamber intraocular lens implantation is the most common ocular surgery being done for cataract and a common complication of this procedure is posterior capsular opacification which leads to impairment of visual function. So the present study was undertaken to evaluate the contrast sensitivity before the after Nd : YAG laser capsulotomy.

Material and Methods

The present study was conducted over a period of one year, on the patients diagnosed as having posterior capsular opacification after uncomplicated cataract surgery with PCIOL implantation. The cases were selected randomly irrespective of age, sex, ethnic origin and occupation.

The patients having media opacities other than Posterior capsular opacification or who were not suitable for capsulotomy or those with disc or macular pathologies were excluded from the study. Further evaluation was done in the following manner:

1. History
2. General Physical Examination
3. Systemic Examination
4. Ocular Examination :- Included

a) *Visual acuity :* visual acuity and best correlated visual acuity was obtained.

b) *Slit lamp examination:* degree of posterior capsular opacification, which was graded according to the Slit lamp appearance ((Grade 0-4), using a protocol based on that described by "Sellman and Lindstrome" using the following scale :

Grade 0- None visible at all

Grade 1 - Visible but none reaching to IOL edge

Grade 2 - At IOL edge

Grade 3 - Well inside IOL edge but visual axis clear

Grade 4 - Across visual axis

c) Ophthalmoscopy

d) I.O.P.

5) *Contrast sensitivity :* All the patients were subjected to contrast sensitivity testing by means of Pelli-Robson chart. It is a large mounted chart 59 cms wide and 8.4 cms in height, that consists of 16 triplets of letters each subtending an angle of 2.8 degree at the intended distance of 1 meter. The triplets are arranged in 8 rows of 2 triplets each. All the patients were made to read the chart at the distance of 1 meter from the top until he /she could not read anymore. The patient was given a credit of 0.05 log units for each letter correctly read by the patient. The final score in log units was calculated on the basis of the number of letters correctly read by the patients. The capsulotomies were performed using Q-switched Nd : YAG by Visualas YAG IIPlus (Zeiss). The capsulotomies were performed by applying series of punctures in a cruciate pattern so as to create an adequate

Table 1. Age & Sex Distribution of Patients

Age in Years	No. of Patients	Percentage	Male	Female
< 20	1	2	1	0
21-30	3	6	3	0
31-40	4	8	3	1
41-50	10	20	4	6
51-60	14	28	5	9
61-70	18	36	14	4
Total	**50**	**100**	**30**	**20**

Table 2. Distribution of Cases According to Grading of PCO

Grade	No. of cases	Percentage %
0	0	0
1	2	4
2	1	2
3	26	52
4	21	42
Total	**50**	**100**

Table 3. Distribution of Cases According to the Relation Between Pre Capsulotomy Contrast Sensitivity and Degree of Posterior Capsular Opacification

Contrast Sensitivity	Grading of Posterior Capsular Opacification			
	1	2	3	4
0-1.50	0	0	14	10
1.55-1.65	0	0	2	8
1.70-1.80	0	1	8	3
1.85-1.95	2	0	2	0
2.00-2.10	0	0	0	0

Table 4. Distribution of Cases According to Visual Acuity before and after laser Capsulotomy

Visual Acuity	No. of cases	Pre-capsulotomy (%)	No. of Cases	Post capsulatomy (%)
< 6/9	0	0	2	4
6/9-6/12	9	18	32	64
6/18-6/24	20	40	11	22
6/36-6/60	15	30	4	8
<6/60	6	12	1	2

Table 5 Distribution of Patients on the Basis of Contrast Sensitivity before and after Capsulotomy

Contrast Sensitivity (Log Units)	Pre-capsulotomy (No. of cases)	Percentage (%)	Post-capsulotomy (No. of cases)	Percentage (%)
0-1.50	24	48	9	18
1.55-1.65	10	20	7	14
1.70-1.80	12	24	8	16
1.85-1.95	4	8	16	32
2.00-2.10	0	0	10	20
2.22	0	0	0	0
Total	**50**	**10**	**50**	**100**

central opening in posterior capsule (2 to 4 mm approx.). The number of shots were variable depending upon thickness of the capsule. Patients were reassessed four weeks post Nd : YAG laser capsulotomy, for evaluating best corrected visual acuity and contrast sensitivity and any complication.

Results (*Table1-5*)

In the present study majority of the patients (36%)belonged to the age group between 61-70 years followed by the age group between 51-60 years (28%).

,before capsulotomy majority of the patients (24%) had contrast sensitivity between 0-1.50 log units followed by 12% between 1.70-1.80 log units. The mean contrast sensitivity was 1.51 +- .32log units . After capsulotomy , majority of the patients had contrast sensitivity between 1.85 t0 1.95 log units followed by 20% in range of 2.00-2.10 log units.The mean contrast sensitivity after capsulotomy was 1.78+-.29 log units.(*Table 5*)

According to students t test there was highly significant mean deviation with p value <.0001 and t value 8.610. according to wilcoxson signed rank test the result was highly significant with p value < .0001 and value 6.123.

Discussion

The present study enrolled patients of different age groups. The maximum number of patients belonged to the age group between 61 to 70 years which included 18 cases (36%), followed by 51 to 60 years which included 14 cases (28%). The mean age of patients in our study was 52.54 + 11.89 years.

Aslam TM *et al* (12). in their study found the mean age to be 75.2 years with the range between (52-90 yrs.) In the present study, we found that incidence of laser capsulotomy was much higher among males which included 30 cases (62%) as compared to females which included 20 cases (38%). The male to female ratio was 1.63:1. Baratz KH *et al* .(13) conducted a study on 2718 patients found women tend to have a greater probability of capsulotomy (P=.17), but this difference was not statistically significant. In the present study we found that the time interval required for development of posterior capsular opacification, after cataract surgery ranged between 1 month to 48 months. With the average time interval came to 6.76 + 8.31 months and median 4. The average time interval came to 5.29 + 3.93 months, on excluding the 2 patients with time interval of more than 26 months. Claesson M et al (10). conducted a study on 13 patients and found impairment of vision due to posterior capsular opacfication, within 2 months after cataract surgery. In addition to a marked visual acuity decrease, all patients had impaired letter contrast sensitivity. Magno B V et al.(11) measured contrast sensitivity before and after capsulotomy, 3 months after cataract surgery. In the present study majority of patients presented with The mean age was 52.94+-11.89 years.In the present study majority of the patients (62%) were males and 38% females.The male:female ratio was 1.63:1.(*Table.1*)Majority of the patients presented with grade 3 posterior capsular opacification(pco)c i.e. 52% of the patients(26 cases) ,42% of the patients presented with grade 4, only 6% presented with less than grade 3.(*Table 2*).In the present study ,before capsulotomy 14 cases with grade 3 PCO had contrast sensitivity between 0-1.50 log units and 8 patients between 1.70 -1.80 log units ,whereas 10 patients with grade 4 had contrast sensitivity between 0-1.50.(table 3).In the present study ,before capsulotomy maximum patients presented with acuity in the range of 6/18-6/24 followed by 30% in the range of 6/36 -6/60 and 6 cases less than 6/60.The visual acuity improved in 64% of cases in the range between 6/9-6/12(32 cases), 22% of cases in the range between 6/18 to 6/24 (11 cases).(*Table 4*).In the present study Grade-3 posterior capsular opacification, 26 cases (52%), followed by 21 cases (42%), with Grade - 4 posterior capsular opacification, followed by 2 patients with Grade 1 and one patient with Grade 2 posterior capsular opacification. 14 cases with Grade 3 PCO had contrast sensitivity between 01.50. Grade 4 PCO had contrast sensitivity between 0-1.50. 2 Patients with Grade 1 PCO had contrast sensitivity between 1.85-1.95 and so the patients with higher grades of posterior capsular opacification had low contrast sensitivity ranges as compared to those with lower grades of posterior capsular opacification, which relates the contrast sensitivity to the degree of posterior capsular opacification before capsulotomy.

Claesson M *et al* .(10) studied 13 patients who had previously undergone extra capsular cataract extraction and intra ocular lens implantation. The density of opacification was graded 0-3. However, no significant correlation was found between the gradings of opacification, density, and the results of visual acuity and contrast sensitivity.

Hayshik *et al*.(14) in their study found no significant correlation between visual acuity, contrast sensitivity or glare sensitivity and the posterior capsular opacification degree after capsulotomy. Before capsulotomy significant

correlation existed between posterior capsular opacification value and visual acuity (r =0.728). This was in accordance with our study.

Aslam T M *et al* .(12) conducted a study on 24 patients. There were two types of posterior capsular opacification assessed, pearls and fibrosis, both graded 0-4. The study confirmed the clinical value of pre YAG measurements of pearls graded at slit lamps.

In our study the power setting ranged from 2-5 millijoules (energy). 32 patients (64%) were treated with power setting of 2-5.5mJ and only 2 cases (4%) needed 5mJ, power setting for capsulotomy. Moreover, we found that a power setting between 2-2.5mJ was effective in 64% of our cases. Wang J *et al.*(15) in a study on 67 cases used energy of single pulse (2.93 + 0.63) mJ.

In the present study, before capsulotomy maximum patients presented with visual acuity in the range of 6/18-6/24. After capsulotomy visual acuity, improved n the range of 6/9-6/12 in 64% cases, followed by 22% in the range of 6/18 -6/24. The mean visual acuity improved by two Snellen lines in 24 cases i.e. almost in half of the cases followed by one Snellen line in 18 cases, followed by three lines 8 cases, post capsulotomy. The following studies also showed improvement in the visual acuity after capsulotomy.

Stark WJ *et al* .(16) showed that a successful opening was achieved n 98% of cases and vision improved in 84% cases.

Albert D W *et al*.(17) reported that 75% of cases in 120 eyes had a posterior capsulotomy visual acuity of 6/12 or better and 54% had 6/9 or better vision. Moreover they found most common factor causing poor visual acuity post capsulotomy was macular edema occurring in 9 out of 26 cases with visual acuity less than 6/6. Whereas in our series one case of macular edema having visual acuity than 6/60 was detected after procedure. Cheng C Y et al .(18) concluded that an Nd : YAG capsulotomy improved visual acuity in patients with both types of posterior capsular opacification in his study on 29 patients.Langrova H *et al*.(19)conducted a study on 20 patients and measured best corrected visual acuity using Snellens chart, before and after capsulotomy. Best corrected visual acuity was significantly lower in patients of posterior capsular opacification when compared to control group (P<.001). Post operative improvement was 1 line on Snellen chart. Wang J *et al* (15) conducted a study on 67 cases and found visual acuity improved with a P<0.01, in all these cases. Aslam TM *et al* (12) concluded mean improvement of distant visual acuity was 0.32 (+ .29), P value <0.0001. Menon G J *et al* .(20) conducted a study on 60 patients in assessing effect of Nd : YAG Laser in context of posterior capsular opacification on visual acuity and contrast sensitivity. They found median spatial acuity (LogMAR) improved from 0.34 (20/44) to 0.16 (20/29) (P<.001), Wilcoxson test. In our present study, contrast sensitivity was measured pre and post capsulotomy in log units in 50 cases using Pelli-Robson chart. Before capsulotomy, majority of the patient (24%) had contrast sensitivity between 0-1.50 log units followed by 12% between 1.70-1.80 log units. The mean contrast sensitivity before capsulotomy was 1.512 + .3201 log units. After capsulotomy, majority of the cases had contrast sensitivity between 1.85-1.95 log units (32%), followed by 20% of the cases in the range 2.00-2.10 log units. None had contrast sensitivity more than 2.10 log units. The mean contrast sensitivity after capsulotomy was 1.779 + .2923 log units.According to students t test the result was highly significant with P value <.0001 and t value 8.610. According to Wilcoxson Signed Rank test the result was highly significant with p value <.0001 and value 6.1231.Hence it was found that contrast sensitivity showed significant improvement after the capsulotomy. our study is in accordance with the following studies.Magno BV *et al* .(11) measured visual functions before and after capsulotomy in 24 patients, using Pelli-Robson chart. Contrast sensitivity improved with a mean difference of 0.24 log units with P<0.0001. Thus, Nd: YAG laser capsulotomy is shown to significantly improve visual acuity, contrast sensitivity and glare disability as compared to pre laser values. Cheng CY *et al* .(18) reported an improvement of contrast sensitivity in patients with both types of PCO in 29 patients. Langrova H *et al* .(19) measured effect of YAG capsulotomy on visual

function in 20 patients and found contrast sensitivity in patients of PCO was significantly lower compared to control group (P<0.05 to P<0.001) and significant improvement was seen post capsulotomy (P<.001). Wang J *et al* .(15)measured contrast sensitivity in 67 cases before and after capsulotomy and found contrast sensitivity improved in all cases. There was very significantly difference (P<0.01).

Hayashi K *et al* .(14) investigated correlation between visual acuity, contrast sensitivity before and after capsulotomy. After capsulotomy mean visual acuity, contrast sensitivity and glare sensitivity all improved significantly (P<.0001). Aslam T M *et al* .(12) measured visual function in 24 patients and mean contrast sensitivity improvement was 0.41(+0.39) with P value <.0001 . This is in accordance with our study. Menon G J *et al* .(20) measured contrast sensitivity Pre and Post capsulotomy in 60 patients and found that median log contrast sensitivity improved from 1.35 to 1.55, from range (0.60 - 1.65) to (1.25-1.75) (P<0.001,). These studies were in accordance with our study, where by the contrast sensitivity is shown to significantly improve after Nd : YAG laser capsulotomy.

Conclusion

It was concluded that posterior capsular opacification is along term complication after cataract surgery with pciol implantation , which causes a decrease in visual function including contrast sensitivity and after Nd:YAG laser capsulotomy the contrast sensitivity improved significantly , as measured by pelli-robson contrast sensitivity chart and statistical tests.

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