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ORIGINAL RESEARCH

Comparative study of hinged and cruciate shaped posterior capsulotomy by Nd- YAG laser in intervention in Jamnagar

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ABSTRACT

Introduction: The denser the PCO there is tendency of more energy to be used, Nd: YAG capsulotomy is associated with significant anterior and posterior segment complications. There are no much studies on impact of Nd: YAG laser energy on the rate of complications and opening patterns of capsulotomy on visual function. **Objectives:**1] To find out association between the grade and type of PCO with energy used and 2] To compare the visual outcome and complications between Hinged pattern and cruciate pattern PCO capsulotomy. **Methodology:** The patients are divided into group A and B, group A underwent cruciate and group B underwent Hinged pattern capsulotomy.A Q- switched Nd: YAG laser Initial setting of 1mJ and subsequent increase of 0.5 mJ as necessary used to make opening in the posterior capsule and the number of pulses used to create capsulotomy and summated total laser energy was noted in each case. Patients were followed for 6 months and analysed.Complications, if any, were treated according to standard protocol with proper follow ups respectively for each variety. **Results:** In this study age of the patients ranged from 16 years to 86 years and the mean age was 62.3+/-18.2.Maximum energy was required for grade 4 (49 mJ) and least for grade 1(8.5 mJ) more energy was required for fibro-membranous and membranous (49 mJ) and least for fibrous (48.5 mJ).In cases who underwent Hinged pattern, complications like IOL pitting and uveitis are common in Hinged pattern compared cruciate pattern, where IOP spikes is a common complication. **Conclusion:** Grade and Type of PCO significantly influenced laser energy levels required for capsulotomy, whereas complications are significantly more common when total laser energy was higher.This new technique of Hinged pattern Nd: YAG posterior laser capsulotomy can be performed safely and is thanCruciate pattern of capsulotomy.

Keywords: Posterior Capsular Opacity, Nd- YAG capsulotomy, Energy used for Capsulotomy, Pattern of Capsulotomy.

INTRODUCTION

Visual impairment is a global health problem. According to previous studies, cataract is responsible for 50% of blindness worldwide. Senile Cataract is the commonest cause of curable blindness in our country. Sushrutha the great Indian sage and surgeon (1500 BCE) first described cataract surgery in his book "Sushrutha Samhitha". Cataract surgery has undergone remarkable evolutionary changes beginning from ICCE, ECCE, SICS and the latest option being phacoemulsification with appropriate IOL implant.[1]Posterior capsular opacification is the most common late complication of cataract surgery as a result of proliferation of residual lens epithelial cells which causes fibrotic changes and wrinkling of the posterior capsule, overall, 25% of patients undergoing extra capsular cataract surgery develops visually significant PCO within 5 years of the operation.[2] PCO present with gradual decrease in visual acuity after successful cataract surgery. Although various methods employed for prevention like capsular polishing, implanting IOL's with convex posterior surface, surface-modified lens, use of antimitotic etc., have not been shown to be very successful in long term follow up.[3] Neodymium: Yttrium-Aluminium-Garnet (Nd: YAG) laser capsulotomy is a safe technique, performed in the outpatient department, for making an opening in the opacified posterior capsules. Nd: YAG laser provides the advantage of cutting the posterior lens capsule, capsular membrane, strands and adhesions without surgical intervention, thereby avoiding and minimizing infection, wound leaks, and other complication of intraocular surgery. Thus Nd: YAG laser capsulotomy is non-invasive, effective and relatively safe technique.[4,5] Need for the study: Nd: YAG capsulotomy is associated with significant

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anterior and posterior segment complications. The denser the PCO there is tendency of more energy to be used so we hypothesized that more energy used for denser PCO. Some studies recommend that side effects are more pronounced when higher single pulse energy levels are used rather than higher total laser energy and proposed that the procedure should be performed at the lowest possible energy level in order to avoid IOL damage.[6] Laser shots can be applied in several patterns such as "Cruciate or Cross pattern", "Can opener", inverted "U-Method" and in a "Hinged pattern". Many authors promote the Introduction use of a cruciate pattern in the Centre of the visual axis, with the clinician starting off on both axes away from the Centre to avoid pitting the lens centrally[7]. There are no much studies on impact of Nd: YAG laser energy on the rate of complications and a causal relation and effects of two different opening patterns in Nd: YAG laser posterior capsulotomy on visual function. This study mainly aims to find the optimal energy required for a particular density of PCO to minimize the complications and to maximize the visual outcome and also to analyse the effect of various forms of PCO capsulotomy openings on visual function after Nd: YAG capsulotomy.

AIMS AND OBJECTIVES OF THE STUDY

1. To find out association between the grade and type of PCO with energy used and its outcome.
2. To compare the visual outcome and complications between Hinged pattern and Cruciate pattern PCO capsulotomy.

MATERIALS AND METHODS:

Source of data: Patients attending the outpatient department of ophthalmology at Guru Gobind Government Hospital, Jamnagar who fulfil the inclusion and exclusion criteria. **Inclusion criteria:** All pseudo phakic patients who presented with diminution of vision due to posterior capsular opacity coming to Guru Gobind Government Hospital OPD having- 1. Evident posterior capsular thickening/opacification on examination with slit lamp Biomicroscope.

2. At least 3 months interval between cataract surgery and development of posterior capsular opacification

3. PCO following complicated cataracts.

Exclusion criteria: Following patients were be excluded from the study:

1. Patients not willing to be the part of the study.
2. Patients < 5 years age.
3. Patients coexisting posterior segment/or, anterior segment ocular diseases such as, Glaucoma, Corneal opacity, Diabetic retinopathy, Age-related macular degeneration and other macular pathologies. Retinal detachment.
4. Un-co-operative subjects like patients with mental retardation, neurological problems.

This was a prospective interventional study done after obtaining approval from the Institutional Ethics Committee, M.P. Shah Government Medical College, Jamnagar from January 2023 to January 2024.Patients with PCO patients fulfilling the inclusion and exclusion criteria were included after obtaining the informed consent from them.Detailed clinical history was taken including date of cataract surgery, interval between cataract surgery and onset of decreased vision, any history of glaucoma, history of any systemic illnesses or surgery, history of any other ocular conditions.

Detailed examination of both eyes along with general physical examination which included Visual acuity testing with Snellen's chart, examination of anterior segment of eye by slit lamp biomicroscope, intraocular pressure using applanation tonometer, examination of posterior segment of eye by ophthalmoscopy (direct and indirect) and +90 D lens and grading of PCO done according to Sellman and Lindstrom grading system.Patients were divided into 2 groups:-Group A that underwent cruciate pattern capsulotomy and group B that underwent hinged pattern capsulotomy. Pupils were fully dilated to create 4mm size capsulotomy and one drop of xylocaine 2% was instilled in conjunctival cul-de-sac. A Q-switched Nd: YAG laser system with wavelength of 1064 nm and pulse length of< 4 ns (2-3ns).

The aiming beam was focused slightly posterior to the posterior capsule. The optical centre of the IOL was matched with the centre of the opening. Initial setting of 1mJ and subsequent increase of 0.5 mJ as necessary used to make an opening in the posterior capsule and the number of pulses used to create capsulotomy and summated total laser energy was noted in each case. Post procedureTab Acetazolamide 250mg OD for 2 days, Moxifloxacin with Dexamethasone eye drops QID, Timolol eye drops BD for 7 days were given and then were called for follow upPatients were visited on first, third and seventh postoperative days, then weekly for two weeks, monthly for two months and on third month. Each visit patient's visual acuity, refraction, fundoscopy and IOP were examined and analysed. Anti-glaucoma medications were not given prior to capsulotomy to any patient.

RESULT

Total 100 patients were identified to have posterior capsular opacification, with age of the patients ranging from 16 years to 86 years(mean age 61.21 +/- 13.2 years). Maximum number of patients presents with grade 3 (42%)and least by grade 1(7%).Females having PCO were greater than males (n=53 vs n=47)(p=0.321) which was not statistically significant.Male patients present with higher grade of PCO (Grade 4: 41.36%) compared to females (grade 4: 29.63%) (p=0.56). Younger age group (< 50 years age) were having greater risk and higher grade of PCO compared to elderly population.Male patients present with higher grade of PCO (Grade 4: 41.36%) compared to females (grade 4: 29.63) which was

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statistically insignificant (p=0.56).Out of 100 patients' maximum number are in membranous (52%) followed by fibrous (33%) and least is fibro-membranous (15%) Among membranous subtype a greater number of patients belong to Grade 3(38.46%) whereas patients with fibrous subtype maximum patients present with grade 4(57.57%) which was found out to be statistically insignificant (p=0.65).

Maximum energy was required for grade 4 (46.18 mJ) (95% CI: 33.15) to 59.22 mJ and was least for grade 1 (9.514 mJ) with 95% CI: 7.84) to 11.17mJ which was statistically significant(p=0.0001).Higher energy was required for fibrous (40.08 mJ)and least for membranous (30.85 mJ) which was found out to be of statistical significance (p<0.001).Maximum single pulse energy was required for grade 4 and grade 3 (1.67mJ) (95%CI :1.243-2.001) and was least for grade 1 (1.28mJ) with (95% CI:1.065-1.506) (p=< 0.0001).

Maximum single pulse energy was required for fibro-membranous type (1.67mJ) (95% CI:1.208-2.064) and least for fibrous (1.52mJ) (95%CI:1.011-2.038). (p=0.033).

Maximum energy used (47.8mJ) for patients with lesser vision (HM- to 1/60). (p<0.001).Both in hinged and cruciate pattern of capsulotomy mean total energy used is almost same (34.53mJ and 34.99mJ respectively)(p=0.8). and visual outcome was almost same in both pattern(p=0,32).

In cases who underwent hinged pattern complications like IOL pitting and uveitis are common compared to cruciate pattern, where IOL spikes is a common complication.24.5% of cases under cruciate pattern of capsulotomy were complaining of floaters compared to 10% cases of hingedpattern after 1 month.(p=0.1159). Around 16% of patients with Hinged capsulotomy showed immediate rise in IOP compared to 24% for Cruciate capsulotomy.(p=0.23).

DISCUSSION

Posterior capsular opacification is the most common late complication of even uneventful cataract surgery. PCO may impair contrast sensitivity or may cause glare and remain a major cause of reduced vision after surgery.

Ajite K.O et al[8], reported on total of 90 patients (109 eyes) seen during the study period with 47(52.2%) being males and 43(47.8%) females and a male to female ratio of 1:0.9. also showed the age range of the patients was 17years to 87years. In our study age of the patients ranged from 16 years to 86 years and the mean age was 61.21+/- 13.2 years. Association of sex with the PCO was not significant it can vary from place to place but chances of occurrence of PCO was common in elder age group and mean age around 70-80 years although Buckley et al.[9], reported that the rate of PCO was high in young children, reflecting greater tissue reactivity. Density of PCO is also more in young children compared to elder. In our study younger age group between presented with higher Grade PCO compared to elder age Group(>50 years) where Grade 3 & 2 are common which may be due to increased chances of proliferation and migration of residual LECs in children.

Dharmaraju et al[10], showed Elschnig's Pearl type of PCO was the most common type (52%) than Fibrous type (33%) and mixed type (15%). In a retrospective study by Baratz[11], cumulative probability of Nd-YAG posterior capsulotomy in Elschnig pearl type posterior Capsular Opacification was common (52%) then fibrous and Mixed type (48%). Among membranous subtype more number of patients belong to Grade 3(38.46%). In patients with Fibrous subtype maximum patients presents with Grade 4(57.57%).

There are only a few published studies [12,13]in the literature which have evaluated the effects of laser energy per se on complication rates and type of PCO on energy levels. Current study evaluated the effect of these factors on the level of energy used for capsulotomy and the correlation between total laser energy levels and the rate of complications. Some studies [4,5] recommend that side effects are more pronounced when higher single pulse energy levels are used rather than higher total laser energy.[14,15]In a retrospective study on 215 eyes with PCO, Bhargava et al [6]found that different PCO subtypes required different initial and total laser energy levels depending on thickness of the posterior capsule (1.5, 1.5 and 1.6 mJ for membranous, fibrous, fibro-membranous opacities respectively). The authors recommended lower single pulse energy levels rather than higher total energy in order to minimize the rate of complications. In our study maximum energy is required for grade 4 (46.18 mJ +/- 4.34mJ) and least is for grade 1(9.51+/- 0.555mJ) which is statistically significant. The starting mean initial energy in the present study was 1.2 mJ and 1.8 mJ for membranous and fibrous forms of PCO respectively which is not significant, but there was a significant difference (P < 0.001) in the total laser energy levels required to create capsulotomy in fibrous and membranous subtypes of PCO.

Complications with Nd: YAG laser capsulotomy were very minimal and transient which could be managed on outpatient basis in regular follow-up. Proper selections of cases is important. Pitting of IOL may occur in uncooperative patients. Nd: YAG laser capsulotomy should be done at least 3 months after cataract surgery to decrease the incidence of iritis. Omotoye O.et al[16] study showed immediate complications following Nd: YAG laser were seen in 21.1% of the patients while 78.9% had no complications from the procedure. Raised intraocular pressure was seen in 10% and Hyphema was seen in only 4.4 %. In our study the complications such as IOP spikes, uveitis, hyaloid face rupture, IOL pitting, CME are common with higher total laser energy levels. 78

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In patients who underwent HINGED pattern capsulotomy there was an immediate improvement of VA compared to these who underwent conventional cruciate method. Mahmooda Soni Wali et al[17] study done on 58 patients were divided into two groups. In one group cruciate pattern of laser shots were given and in the 2nd group HINGED pattern of laser shots was used. Immediate visual outcome on 1st day was better with HINGED pattern. The incidence of IOP spike was less with HINGED pattern as compared to cruciate pattern. The IOL Lens pitting, CME and retinal detachment were not observed in patients who underwent HINGED pattern laser capsulotomies. 24.5% of cases under cruciate pattern of capsulotomy were complaining of floaters compared to hinged only 10% after 1 month. This data was statistically not significant for Hinged shaped Pcotomy being better than Cruciate shaped option to reduce floaters after one month post procedure (p=0.1159). Cruciate pattern of capsulotomy patients having more complaint of glare than hinged pattern of capsulotomy. Statistically not significant (p=0.56941). In the study by Shetty et al[18], it was observed that almost all the patients had a rise in IOP 2 hours post-procedure irrespective of the number of shots. Hence IOP documentation of IOP 2 hours post-procedure was observed to be more predictive of persistent IOP rise compared to immediate post-procedure IOP. In a study by Manav Singh, Nidhi Sharma et al.[19], the rise of IOP from baseline to 1 hour, 3 hour, 5 hour and 24 hours post-procedure was not found to be significant in the groups receiving ocular hypotensive drug. In the group receiving placebo, the rise of IOP reached statistical significance at 1, 3 and 5 hours post laser which came down to insignificant levels at 24 hours. In a study by Kraffet al.[20], they found that post laser IOP rise was lesser in pseudophakics as the IOL blocked cortical material from reaching trabecular meshwork and clogging with particulate matter. Geet al.[21], found IOP rise to be more significant in glaucomatous than non glaucomatous patient, 1hour post-capsulotomy; We had excluded patients having pre existing glaucomatous changes from our study. Shani et al., could not find any elevation of IOP and postulated that healthy pseudophakic eyes do not generally show elevation of IOP after Nd:YAG laser capsulotomy. Ari et al., also did not find any persistent rise in IOP. However, none of the studies correlated the Pattern of Posterior capsulotomy to the IOP spikes. In our study, 1-2 mm of hg IOP rise was seen in 15% of patients immediately after the procedure followed by 2% of patients shoeing rise of 3-4 mm of Hg and 3% showing spike greater than 5 mm of Hg than the baseline normal value have higher chances immediately after PCO capsulotomy. Around 16% of patients with Hinged capsulotomy showed immediate rise in IOP compared to 24% for Cruciate capsulotomy. Post 2 hrs of the procedure, greater reduction was found in the cases for around 16% in case of Cruciate capsulotomy than 8% in Hinged shaped capsulotomy In our study in cases who underwent Cruciate pattern complications like IOL pitting (71.43%), uveitis (50%) and CME (100%) are common compared HINGED pattern IOP spikes (60%) is common in cruciate pattern compared to HINGED pattern.

CONCLUSION: Grade and Type of PCO significantly influenced laser energy levels required for capsulotomy, whereas complications are significantly more common when total laser energy was higher.This new technique of Hinged pattern Nd: YAG posterior laser capsulotomy can be performed safely and is than Cruciate pattern of capsulotomy.

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