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RESEARCH ARTICLE

“A CLINICAL STUDY OF NEODYMIUM YAG LASER CAPSULOTOMY- THE PATTERN AND ENERGY USED FOR VARIOUS GRADES OF PCO AND OUTCOME”.

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Abstract

Background : 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: To find out association between the grade and type of PCO with energy used. 2] To compare the visual outcome and complications between circular pattern and cruciate pattern PCO capsulotomy

Methodology: The patients are divided into group A and B, group A underwent cruciate and group B underwent circular 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 analyzed.

Results: In this study age of the patients ranged from 6 years to 86 years and the mean age was 62.3+/- 18.2. Maximum energy is required for grade 4 (46.6 mJ) and Least is for grade 1(9.7) More energy is required for fibrous (39.2mJ) and least is for membranous (26.7mJ). In cases who underwent circular pattern. Complications like IOL pitting and uveitis are common in circular 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 cruciate pattern Nd: YAG posterior laser capsulotomy can be performed safely but visual prognosis is better in circular pattern of capsulotomy.

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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 “SushruthaSamhitha”. Cataract surgery has undergone remarkable evolutionary changes beginning from ICCE, ECCE, SICS and the latest option being phacoemulsification with appropriate IOL implant.1

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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 antimitotics etc., have not been shown to be very successful in long term follow up.³

Neodymium: Yttrium-Aluminum-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 noninvasive, effective and relatively safe technique.⁴

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 analyze the effect of various forms of PCO capsulotomy openings on visual function after Nd: YAG capsulotomy.

The incidence of PCO is known to range from as high as 50% to as low as <5% in eyes undergoing cataract surgery for uncomplicated senile cataracts¹⁴. There is significant heterogeneity among published rates of PCO. The overall pooled estimates (95% confidence limits) of the incidence of PCO were 11.8% (9.3%-14.3%) at 1 year, 20.7% (16.6%-24.9%) at 3 years, and 28.4% (18.4%-38.4%) at 5 years after surgery. There is no evidence of a significant decline in PCO incidence during the study period. PCO reduces visual acuity when the central area (inside the pupillary aperture) is involved⁵.

Several systemic and ocular associations have been cited for influencing the development of PCO. The review of case records to evaluate the risk factors for PCO has revealed no correlation between PCO and age, gender, or axial length. At the one- year follow-up, diabetic patients had significantly severe PCO after cataract surgery when compared with non-diabetic patients. However, amongst the diabetics, the stage of diabetic retinopathy and the systemic status of diabetes did not seem to correlate with the degree of PCO⁶. Myopic eyes were postulated to have an increased risk of PCO probably because IOL implantation was deferred in them. However study with IOL implantation in myopic eyes showed no association between degrees of myopia to degree of PCO. The incidence of PCO is also high in eyes with uveitis⁷. In these eyes, hydrophobic acrylic IOLs have shown to provide a better visual outcome and lower incidence of PCO than silicone, PMMA, or heparin-surface-modified PMMA IOLs⁸. Patients with myotonic dystrophy have required multiple capsulotomies following cataract surgery. Similarly, patients with retinitis pigmentosa showed a significantly higher incidence and density of PCO⁹. In traumatic cataracts, the incidence of PCO is significantly higher and has been quoted to be as high as 92% at the three-year follow-up¹⁰.

Materials And Methods:-

This study was after obtaining approval from the institutional ethical committee and written informed consent was taken from the patients in their own language. It is a Hospital based Prospective interventional study. The materials for the present study drawn from patients attending the outpatient department of ophthalmology at Santhiram medical college & general hospital. After considering the below criteria, patients were selected into the study.

Inclusion Criteria:

All patients presented with diminution of vision due to posterior capsular opacity coming to Santhiram medical college & general Hospital OPD having-

1. Evident posterior capsular thickening/opacification on examination with slit lamp.
2. Post-op cataract surgery, decrease in vision by at least 3 lines on Snellen's chart.
3. At least 3 months interval between cataract surgery and development of posterior capsular opacification.
4. PCO following complicated cataracts.
5. Pre-existing posterior capsular opacification (present before cataract surgery).

Exclusion Criteria:

1. Following patients will be excluded from the study
2. Patients < 5 yearsage.
3. Eyes with subluxated intraocularlens.
4. Includes severe coexisting oculardisease, Glaucoma

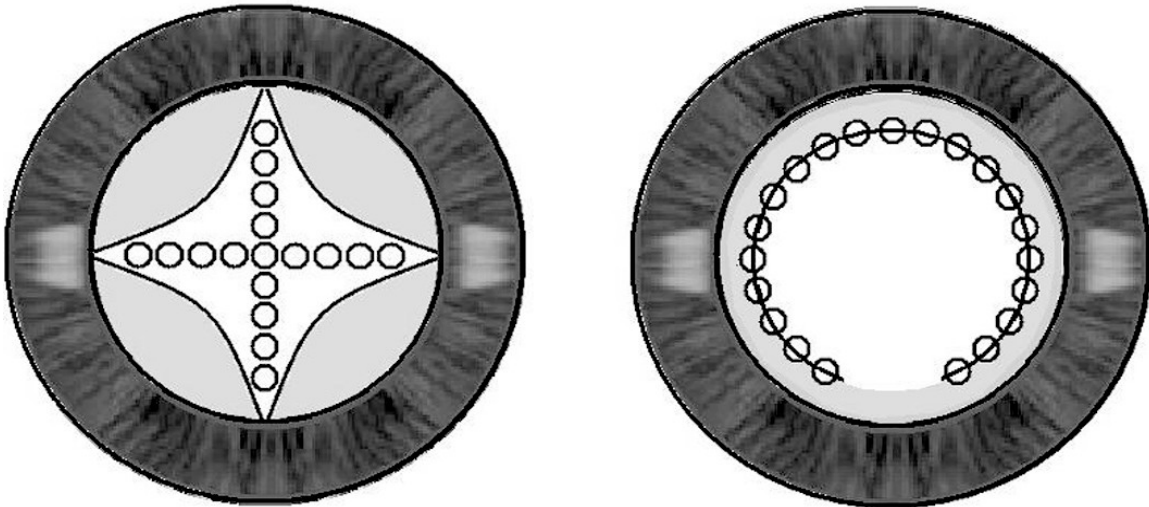
Corneal opacity Diabeticretinopathy

Age-related macular degeneration and other macular pathologies. Retinaldetachment.

Un-co-operative subjects. Eg: patients with mental retardation, neurologicalproblems. Aphakiceyes.

The patients are divided into group A and group B, group A underwent cruciate and group B underwent circular patterncapsulotomy.

In cruciate pattern posterior capsulotomy laser shot is first aimed superiorly at near 12 Clock in the location of fine tension lines and progressing downwards towards the 6 o' clock position, shots are then placed at the edge of the capsule opening, progressing laterally towards the 3 and 9 o' clock positions. In circular pattern a circle of laser shots put starting from 6 o' clock position with a diameter of 4-5 mm.

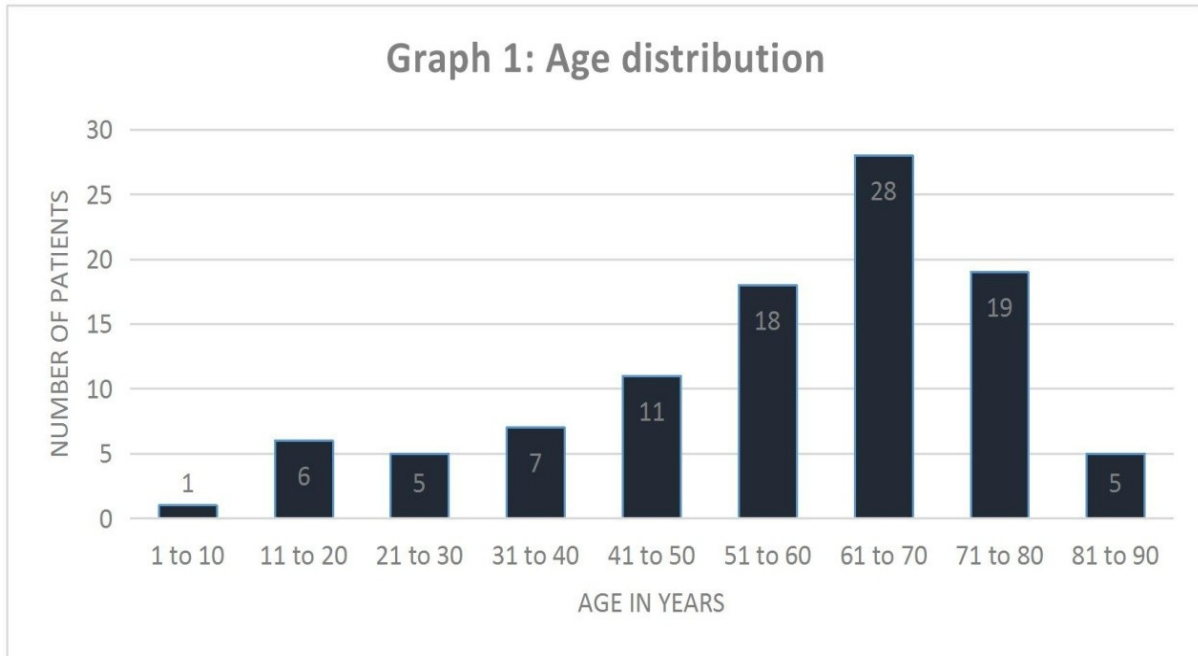


The aiming beam was focused slightly posterior to the posterior capsule. The optical center of the IOL was matched with the center of the opening. Initial setting of 1mJ and subsequent increase of 0.5 mJ as necessary used to make an opening in the posterior capsule and the number of pulses used to create capsulotomy and summated total laser energy was noted in each case.

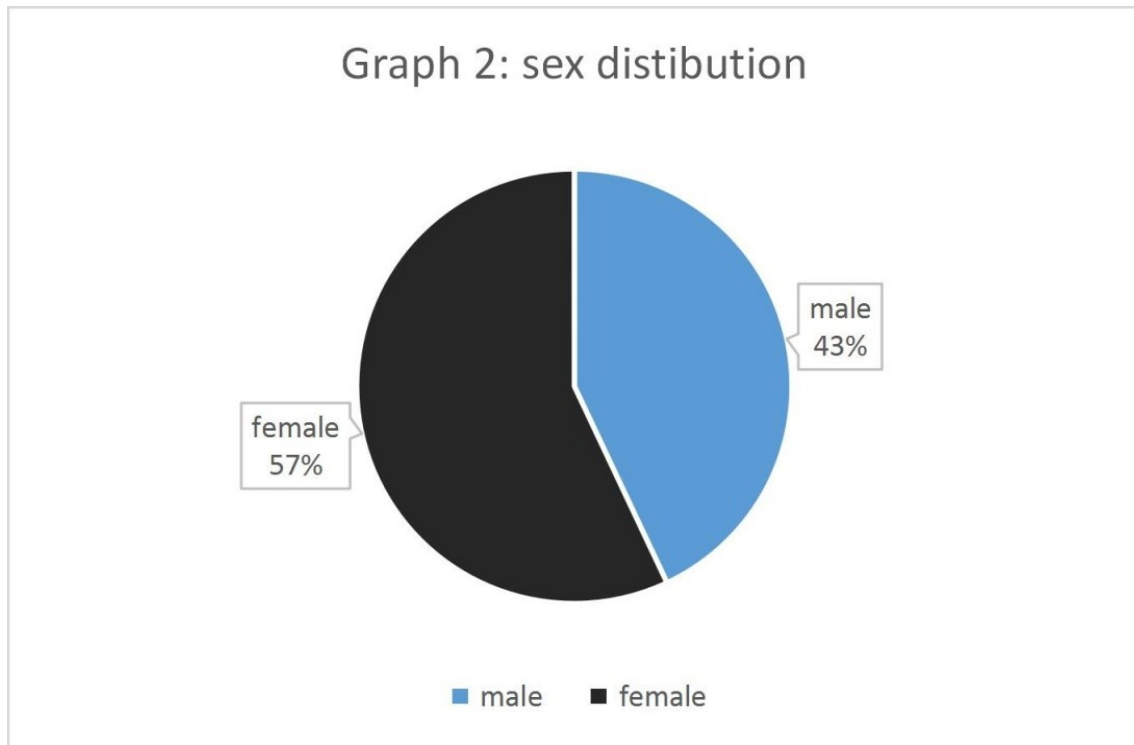
Post procedure Tab Acetazolamide 250mg BD, Moxifloxacin with Dexamethasone eye drops QID, Nepafenac eye drops BD depending on the inflammatory response and raised IOP. Antiglaucoma medications were not given prior to capsulotomy to any patient.

Patients were visited on first, third and seventh postoperative days, then weekly for two weeks, monthly for two months and on third month. Each visit patients visual acuity, refraction, fundoscopy and IOP were examined and analyzed. More frequent follow up visits may be considered in patients with complications.

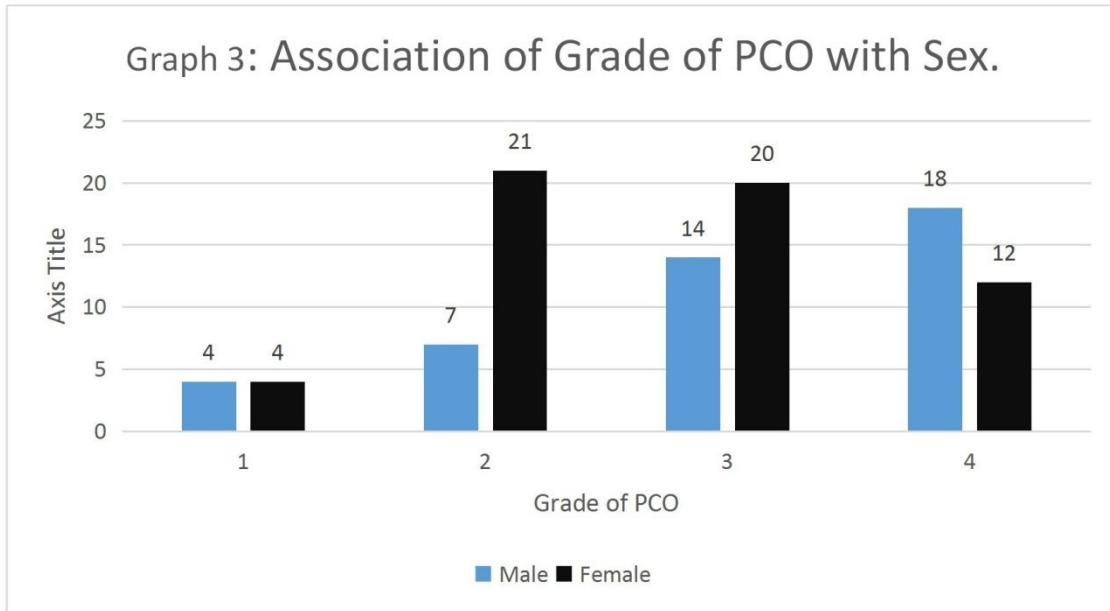
Results And Observations:-



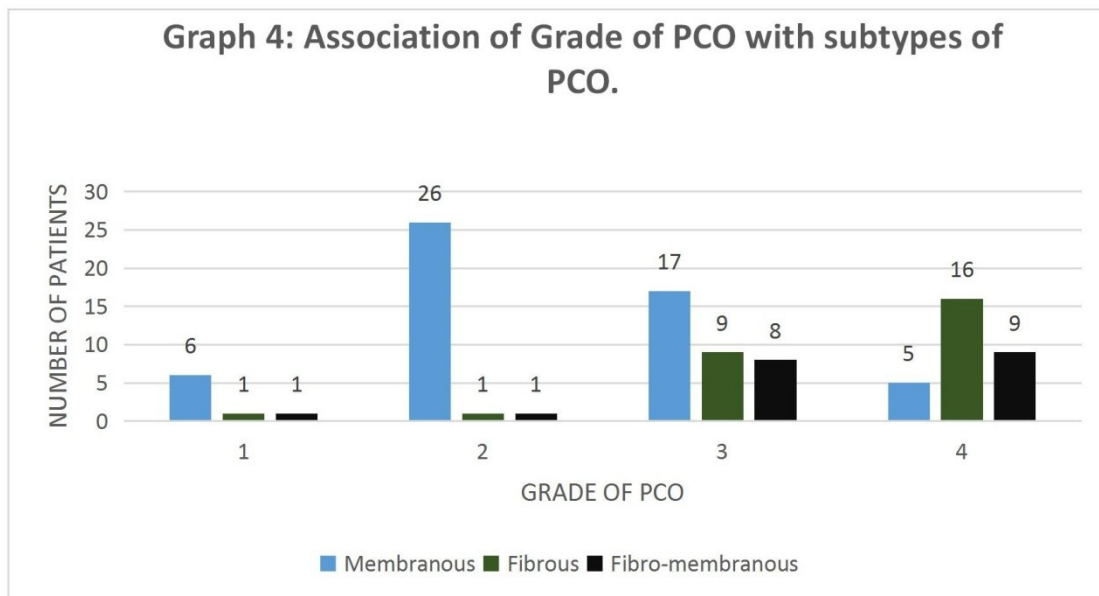
Graph 1:- showing more number of patients belong to 61 to 70 years of age group and least at 1 to 10 years of age group. As the age increases number of patients with PCO increases because of increased rate of cataract surgeries in elder age group.



Graph 2:- showing sex distribution of PCO females have higher chances compared to males.



Graph 3:- showing female patients presents with lesser grade of PCO and males with Highergrade.



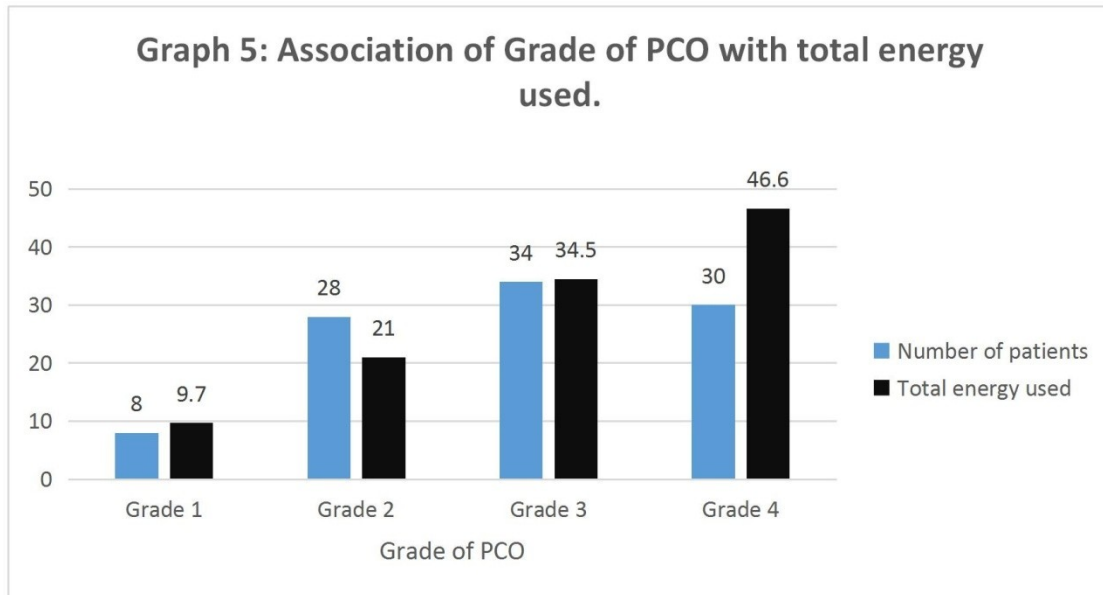
Graph 4:- showing more number of patients are membranous with lesser grade of PCO and less number of patients are fibrous and fibro membranous with higher grade of PCO.

Table 1:- Association of Grade of PCO with total energy used.

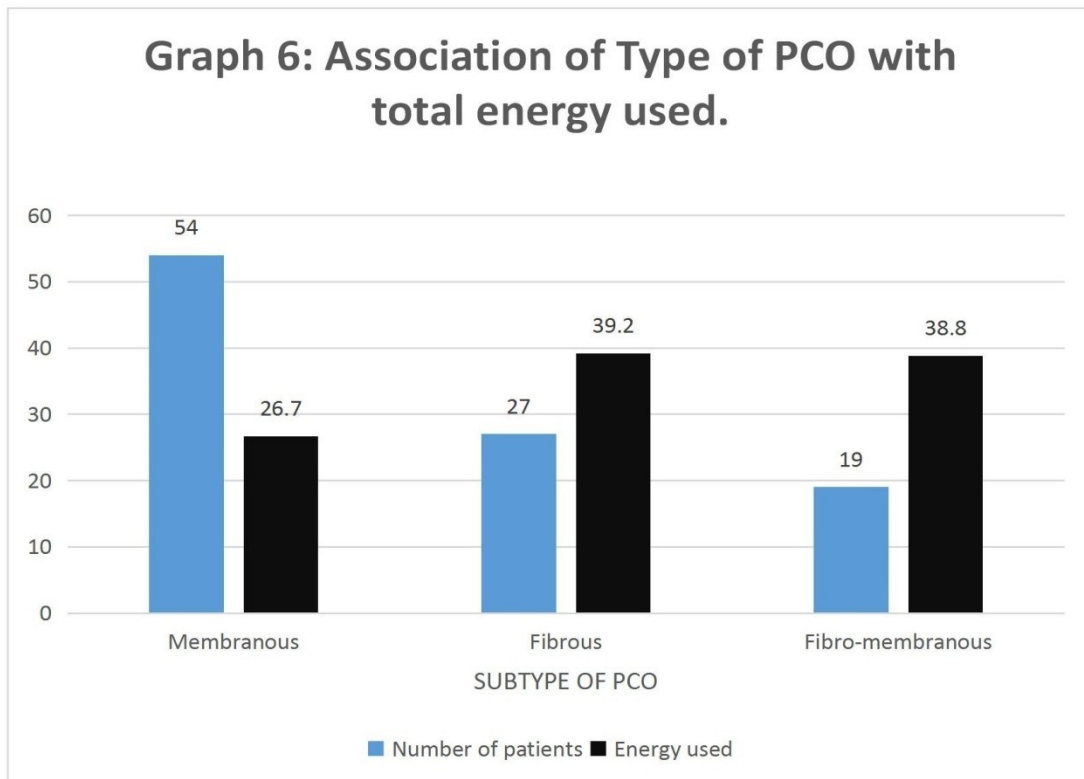
GRADE	NO.OF PATIENTS	MEAN ENERGY(mj)	95% Confidence Interval for Mean	
			Lower Bound	Upper Bound
1	8	9.7	6.992760	12.507240
2	28	21.0	18.521980	23.0563734
3	34	34.5	30.830898	38.169102

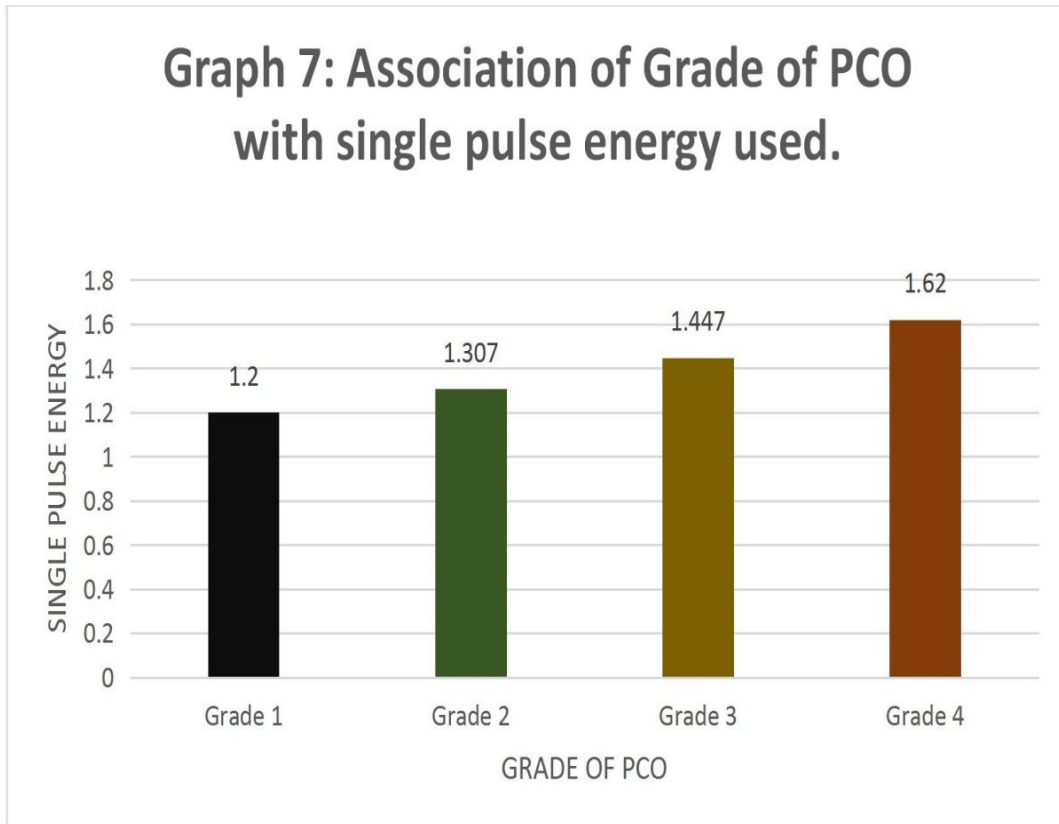
4	30	46.6	44.03124	49.248754
			6	
TOTAL	100	32.3	29.55752	35.230477
			3	

Maximum number of patients presents with grade 3 and least by grade 1, Maximum energy is required for grade 4 (46.6 mj) with 95% confidence interval of 44.03-49.2 and Least is for grade 1 (9.7) with confidence interval of (6.99-12.5). Which is statistically significant with $p < 0.001$

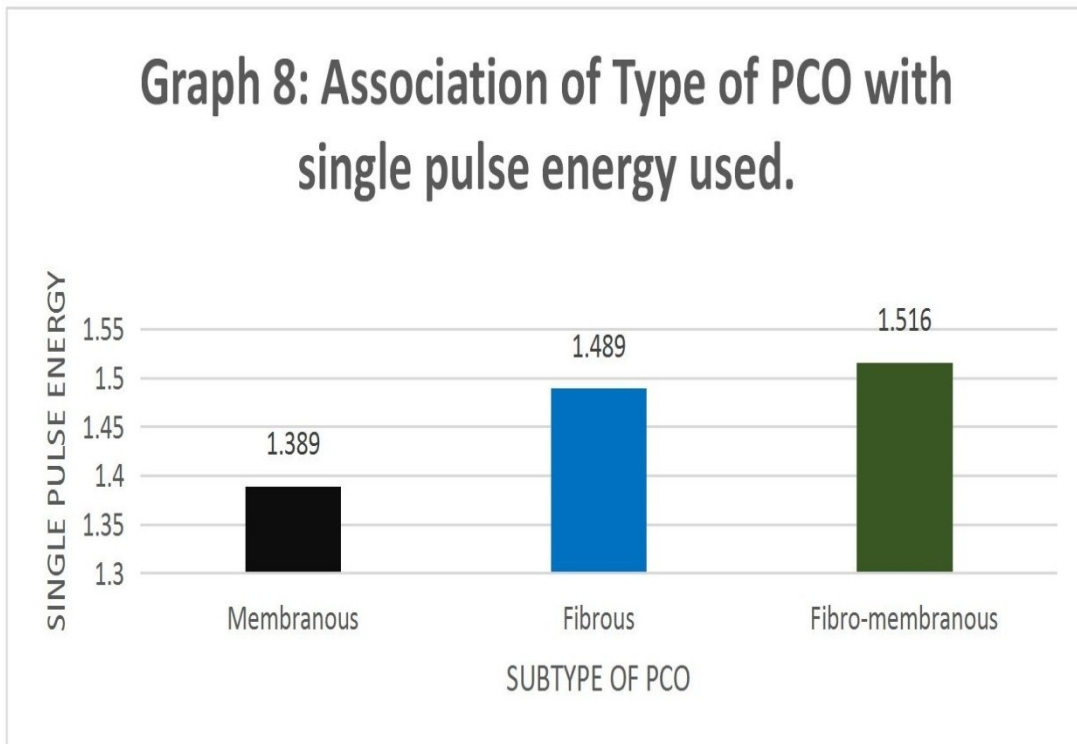


Graph 6:- Showing fibrous and fibro-membranous requires higher energy compared to membranous subtype.

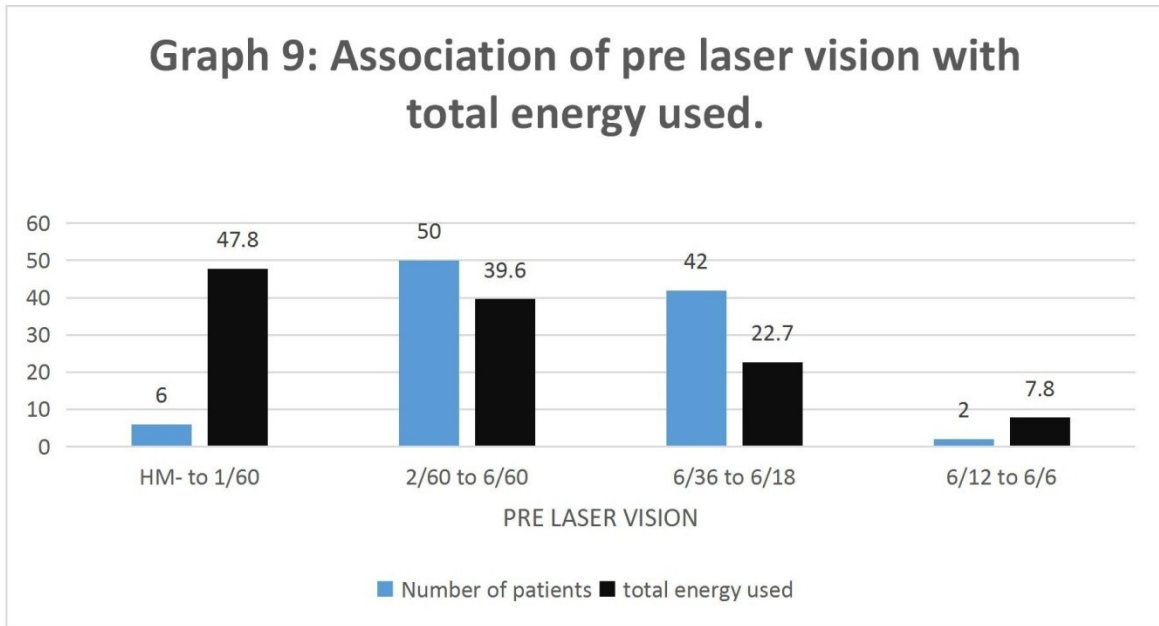




Graph 7:- showing higher the grade higher the single pulse energy required.



Graph 8:- showing fibro-membranous requires higher single energy compared to membranous.



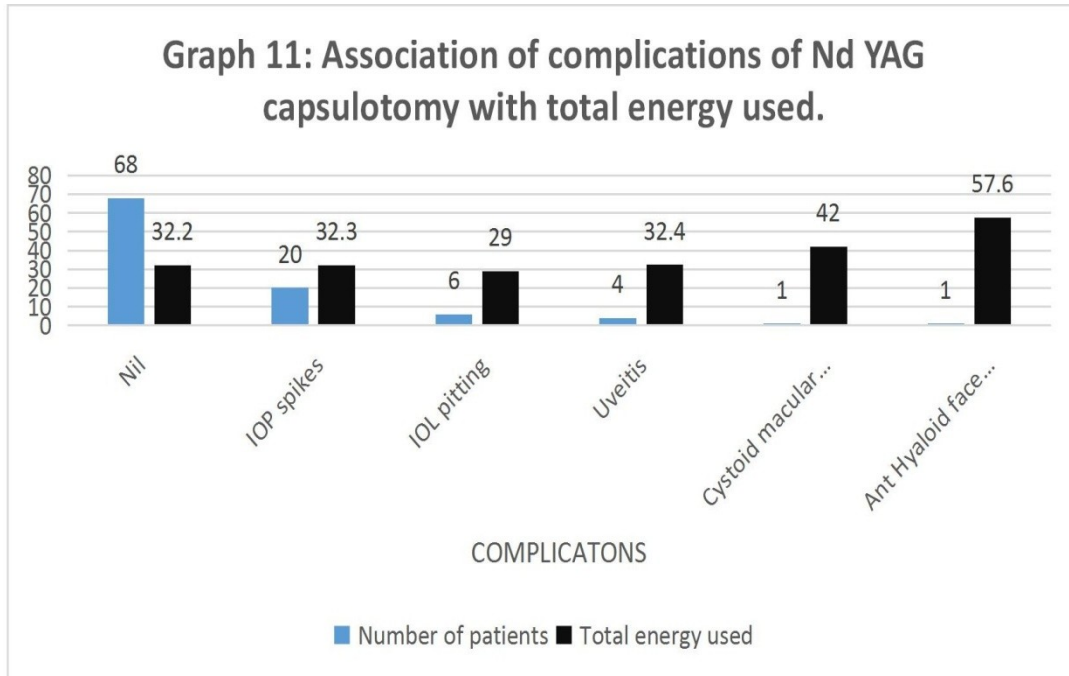
Graph 9:- showing higher the diminution of vision higher the energy required.

Maximum number of cases are in pre laser vision between 2/60 to 6/60 (50 cases), among them 52% improved to 6/36- 6/18 and 32% improved to 6/12 to 6/6 and 16% remained in same group. There were only 2 patients before laser in the group 6/12 to 6/6 and it is increased to 45 after the Nd YAG laser capsulotomy in the same group. It is not statistically significant.

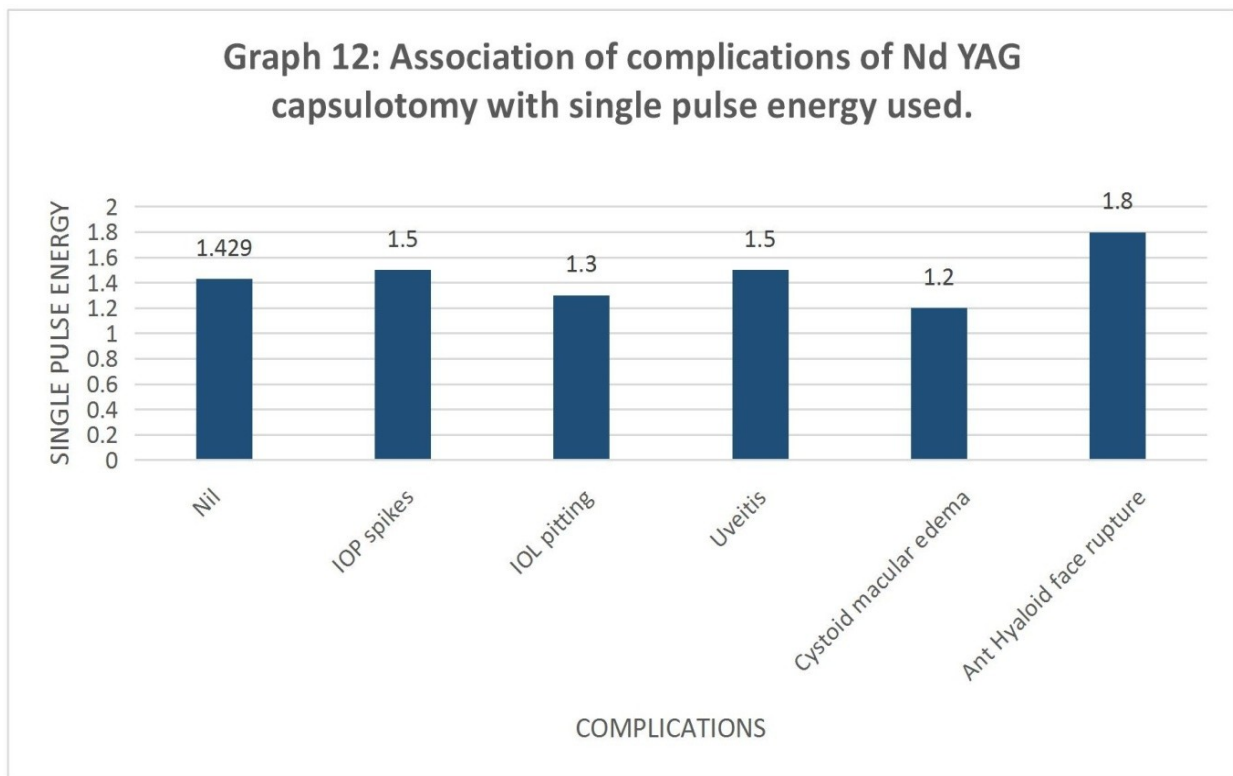
Table 2:- Association of complications of Nd YAG capsulotomy with total energy used.

COMPLICATION	N	MEAN TOTAL ENERGY	95% CONFIDENCE INTERVAL FOR MEAN	
			LOWER BOUND	UPPER BOUND
Nil	68	32.2	28.8	35.5
IOP spikes	20	32.3	25.9	38.7
IOL pitting	6	29.0	19.0	38.9
Uveitis	4	32.4	10.8	75.6
Cystoid macular Edema	1	42.0	-	-
Ant. Hyaloid face Rupture	1	57.6	-	-
Total	100	32.4	29.5	35.2

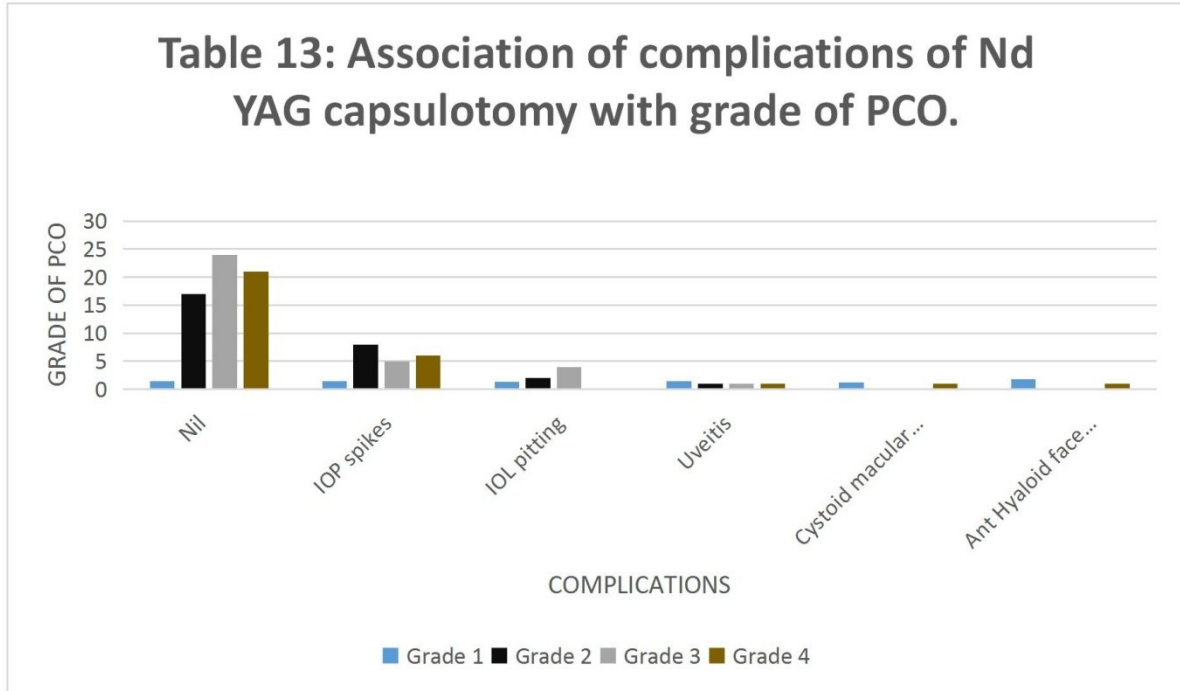
The complications such as IOP spikes, uveitis, hyaloid face rupture, IOL pitting, CME are common with higher total laser energy levels. It's not statistically significant.



Graph 11:- showing higher the total energy used higher the rate of complications.



Graph 12:- showing rate of complications is more when higher the single pulse energy used.

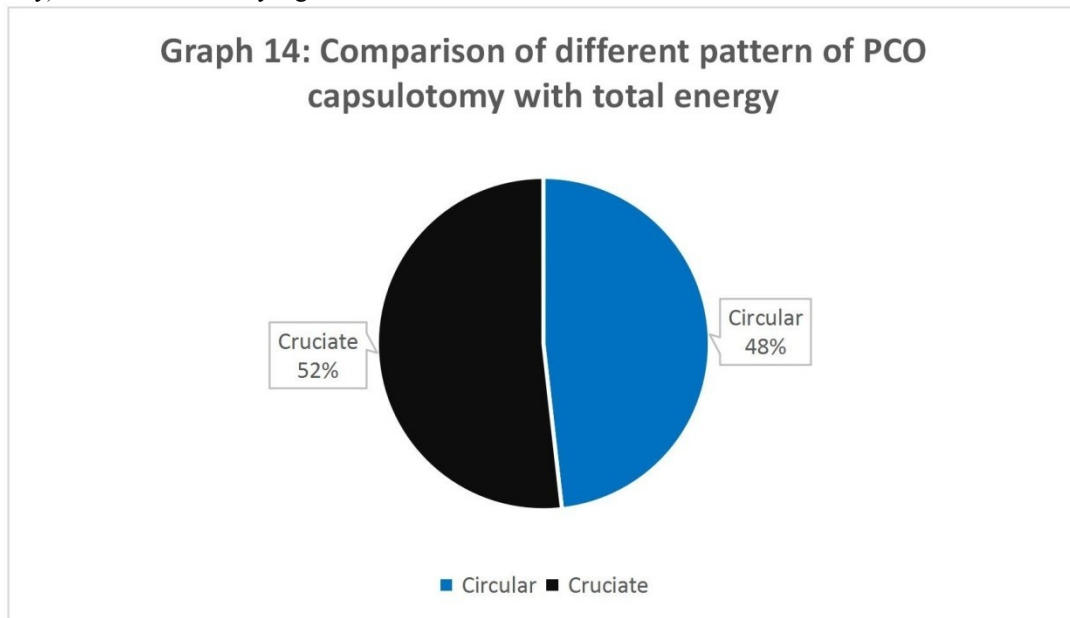


Graph 13:- showing Grade 2 and Grade 3 PCO cases presents with higher rate of complications after Nd: YAG laser capsulotomy.

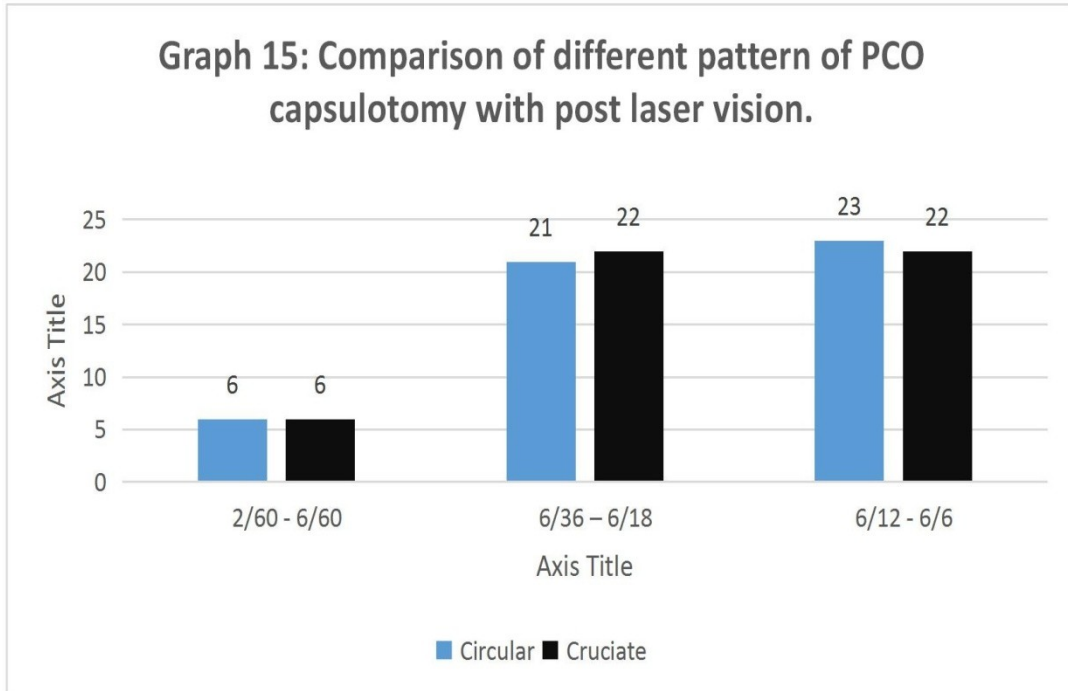
Table 3:- Comparison of different pattern of PCO capsulotomy with total energy.

Pattern of PCO	N	Mean total energy
Circular	50	31.2
Crucial	50	33.5

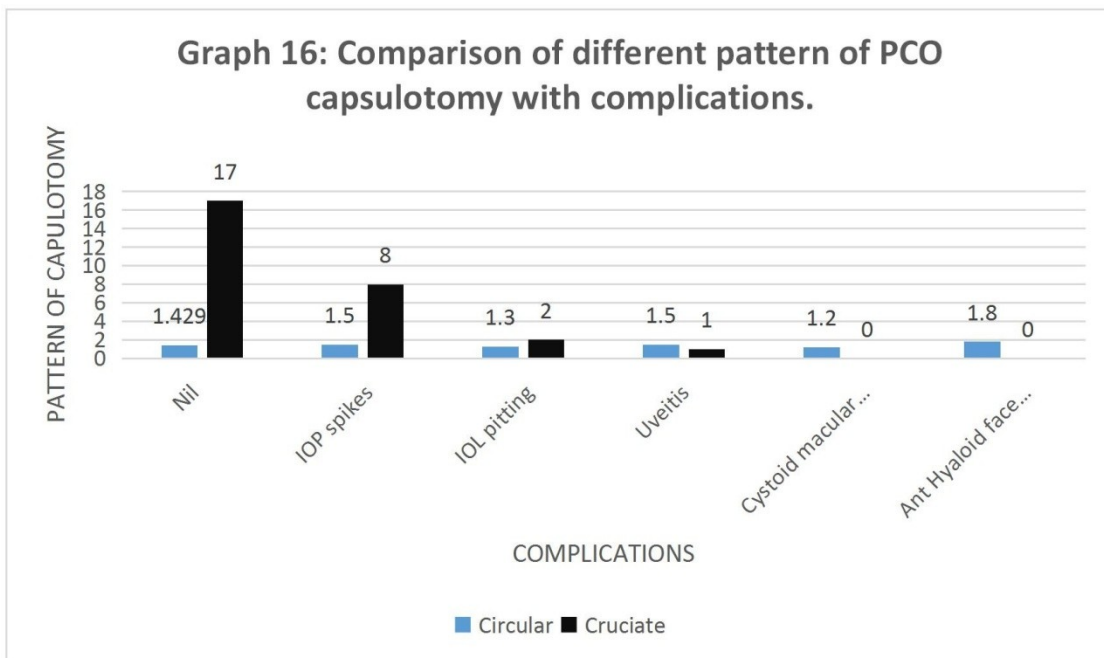
Both in circular and cruciate pattern of capsulotomy mean total energy used is almost same (31.2 and 33.5 respectively) it is not statistically significant.



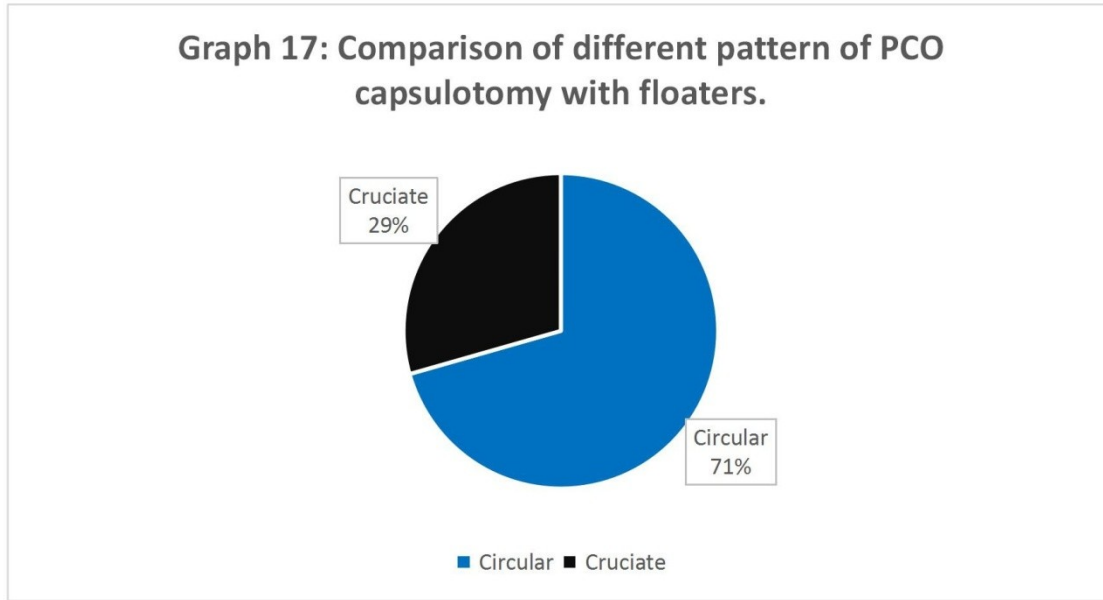
Graph 14:- showing cruciate pattern capsulotomy requires little higher energy compared to circular pattern Nd: YAG capsulotomy.



Graph 15:- showing both circular and cruciate pattern capsulotomy have almost same outcome.



Graph 16:- showing complication rate is more with the cruciate pattern capsulotomy compared to circular pattern.



Graph 17:- showing circular pattern have higher chances of having floaters compared to cruciate pattern capsulotomy.

Discussion:-

Posterior capsular opacification is the most common late complication of even uneventful cataract surgery. Nd: YAG laser capsulotomy is the mainstay of treatment for PCO.

In our study age of the patients ranged from 6 years to 86 years and the mean age was 62.3 \pm 9.2 years. Maximum number of patients with PCO are in age group of 61-70, Maximum in females 57% compared to males 43% and male to female ratio is 1:1.3. Association of sex with the PCO is not significant it can vary from place to place but chances of occurrence of PCO is common in elder age group and mean age around 60-70 years.

In our study Younger age group between 1-30 years present with higher Grade PCO compared to elder age Group (>50 years) where Grade 3 & 2 are common. Which is statistically significant with $p = 0.03$. This may be due to increased chances of proliferation and migration of residual LECs in children.

In our study, Out of 100 patients maximum number are in membranous (54%) followed by fibrous (27%) and least is fibro-membranous (19%). Among membranous sub-type more number of patients belong to Grade 2 (48.1%). In patients with Fibrous subtype maximum patients presents with Grade 4 (59.3%). Severe PCO (grade 4) were about 30%, moderate (grade 2 and 3) were 68% and mild (grade 1) were 8%.

In our study maximum energy is required for grade 4 (46.6 mJ \pm 11.2mJ) and least is for grade 1 (9.7 \pm 3mJ) which is statistically significant.

Complications such as IOP spikes, uveitis, hyaloid face rupture, IOL pitting, CME are common with higher total laser energy levels. Single case of anterior hyaloid face rupture was noted with highest energy used 57.6 mJ.

In our study in cases who underwent circular pattern complications like IOL pitting (83.3%), uveitis (75%) and CME (100%) are common compared cruciate pattern IOP spikes (55%) and Hyaloid face rupture (100%) is common in cruciate pattern compared to circular pattern.

Conclusion:-

Association of sex with the PCO is not significant it can vary from place to place but chances of occurrence of PCO is common in elder age group.

More number of patients presented with membranous followed by fibrous and least is fibro-membranous, among membranous subtype more number of patients belong to Grade 2, Whereas in patients with Fibrous subtype maximum patients presents with Grade 4.

More number of patients presents with grade 3 and least by grade 1, energy required for grade 4 significantly high compared to grade 1. Grade and Type of PCO significantly influenced total and single pulse laser energy levels required for capsulotomy.

Whereas Complications such as IOL pitting, uveitis, IOP elevation, hyaloid face rupture and CME was significantly more common when total laser energy was higher, complications like IOP spikes found more in grade 2 PCO cases, IOL pitting in grade 3 cases, one case of CME and one case of anterior hyaloid face rupture which is seen in Grade 4 PCO cases.

The cruciate pattern Nd: YAG posterior laser capsulotomy can be performed safely but visual prognosis is better in circular pattern of capsulotomy. Complications like IOL pitting, uveitis and CME are common in cases who underwent circular pattern compared to cruciate pattern IOP spikes and Hyaloid face rupture is common in cruciate pattern.

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