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A Study of the Impact of ND: Yag Laser Posterior Capsulotomy on Foveal Thickness and Central Corneal Thickness by Using Spectral Domain Optical Coherence Tomography

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Abstract: ***Posterior capsule opacification (PCO) is a common post - cataract surgery complication, resulting from the proliferation and migration of residual lens epithelial cells. Nd: YAG laser capsulotomy is the standard non - invasive treatment for PCO, though it carries risks such as corneal endothelial damage, increased intraocular pressure, and retinal detachment. This observational study aimed to assess the effects of Nd: YAG laser capsulotomy on foveal and central corneal thickness using spectral domain optical coherence tomography (SD - OCT). Fifty patients, aged 20 - 60, with clinically significant PCO and a best - corrected visual acuity (BCVA) of <20/40 or <6/9, underwent capsulotomy. Foveal and central corneal thickness were measured before the procedure, one hour post - procedure, and at a 15 - day follow - up using SD - OCT. Capsulotomy was performed using the Zeiss VISULAS YAG III. Capsular fibrosis was the most common form of PCO (78%), followed by Elschnig's pearls (22%). A significant increase in central corneal thickness was observed one hour after capsulotomy (540.58 ± 28.96, p < 0.001), compared to baseline (530.72 ± 18.97). No significant changes in foveal thickness were noted at any time point. The study concludes that Nd: YAG laser capsulotomy is a safe and effective treatment for PCO, with no adverse effects on the macular fovea when performed under controlled conditions.***

Keywords: Posterior capsular opacification, Nd: YAG laser capsulotomy, foveal thickness, central corneal thickness, spectral domain OCT

1. Introduction

Posterior capsule opacification (PCO) is a physiological postoperative consequence of an uneventful uncomplicated extracapsular cataract surgery. Capsular opacification is different from the intraoperative opacification that takes place in the intact lenses. It is referred to as a plaque, which can be in the anterior and/or posterior capsule. PCO referred to as 'secondary cataract' or 'after cataract', develops over the clear posterior capsule a few months to a few years after an uneventful cataract surgery.[1] It occurs when remaining epithelial cells proliferate and migrate to the space between the IOL and the posterior capsule. Epithelial cells contract and produce wrinkles and opacity in the posterior capsule. This opacity diminishes visual acuity, contrast sensitivity, stereoscopic and color vision. It also can produce glare and monocular diplopia.[2]

Introduction of sharp - edge optic intraocular lenses and the development of the modern phacoemulsification technique have resulted in reduced rates of PCO. However, PCO is still the most common problem following cataract surgery.[3]

Neodymium: yttrium - aluminum - garnet laser capsulotomy is the standard treatment for PCO. Nd: YAG laser is a solid - state laser with a wavelength of 1064 mm that can disrupt ocular tissues by achieving optical breakdown with a short, high - power pulse. Optical breakdown results in ionization, or plasma formation, in the ocular tissue. This plasma formation then causes acoustic and shock waves that disrupt tissue.[4]

While Nd: YAG laser capsulotomy is generally safe and effective, complications such as corneal oedema, cystoid macular edema, retinal detachment, [5] and rise in intraocular pressure (IOP) [6] may occur.

Macular edema is caused secondary to Nd: YAG laser due to acoustic and shock waves is caused in the vitreous cavity and release of inflammatory mediators due to the damage of blood - aqueous barrier. Elevated IOP is associated with an increased amount of aqueous particles following Nd: YAG laser capsulotomy[7]. Ari et al. underlined that the severity and duration of increased IOP and macular thickness are less when a total energy level less than 80 mj is used.[8] There are few studies about the pure effect of laser capsulotomy on central corneal thickness, IOP and macular thickness when Nd: YAG laser is used with similar energy levels.

Aim of this study was to examine the influence of Nd: YAG laser capsulotomy on central corneal thickness and macular thickness using spectral domain OCT.

2. Literature Survey

Cataract surgery is currently the most common and well - established ophthalmic surgical procedure in the world. This procedure involves the extracapsular extraction of the natural opaque lens fibers and implantation of an intraocular lens, which restores good vision.[9] However, PCO which is also termed *secondary cataract*, is a common long - term complication of modern cataract surgery. The first IOL implantation was performed by Sir Harold Ridley in 1950.

Since that time, the technology has undergone a wide variety of improvements that reduced the incidence of PCO but did not eliminate it as a significant clinical problem. Decreased visual acuity induced by PCO is reported to occur in 20% to 40% of patients 2 to 5 years after surgery. Posterior capsular opacification development is age dependent, with a low incidence in older patients but high rates in young patients, especially children and infants.[9] As per study done by Burq MA et al, PCO is the most common late post - operative complication of cataract surgery, occurring in up to one - third of patients in a period of five years.1[0] Studies done by Niranjan Awasthi et al, showed that the decreased in visual acuity induced by PCO is reported to occur in 20 - 40 % of patients in 2 to 5 years after cataract surgery.[9] According to a study done by Gregor Hawlina at University Medical Centre Ljubljana, PCO was found to be the most common visually disabling consequence of modern cataract surgery and has important medical, social and economic implications. It was also reported that the visually significant PCO rate was overall to be approximately 28% at 5 years.[11] A study by Mohammad Younas Khan et al, the capsular fibrosis type of PCO was found in 36% of cases, Elschnig's pearls was found in 12% and 9% had capsular wrinkling. The relative incidence of different types of PCO showed that the capsular fibrosis was the predominant type of PCO as compared to Hasan et al study, who reported elschnig's pearls in pseudophakic eyes and secondary fibrosis in aphakic eyes as the predominant type encountered. They also observed that the macular oedema was seen in 1% of the patients.[12] According to a study by Burq MA, the most common complication of Nd: YAG laser posterior capsulotomy was elevation in intraocular pressure which was found to be transient. Other complications included retinal cystoid macular edema, glaucoma, intra - ocular lens damage, iritis and endophthalmitis. RD remains an infrequent but vision - threatening complication.[10] A study by Halás M Jr et al, was done to evaluate anatomical changes in the macular region after Nd: YAG using OCT where 36 patients were evaluated where minimal foveal thickness (MFT) and macular volume (MV) were evaluated.

Average MFT in day 1 was 197.63 ± 10.3 µm, median 189 ± 9 µm and after 1 month was 189.63±11.5µm, median 184±9µm.

Average MV in day 1 was 6.53 cu mm and after 1 month was 6.51 cu mm.

They found that the changes in the foveal minimal thickness and macular volume was not significant.[13] The Altiparmark et al, study showed the impact on foveal thickness measurement by OCT, which did not significantly change in the first year after laser treatment. Cystoid macular edema developed in only patient (2%). Fifty - four eyes of 54 patients were enrolled for this study. Average MV in day 1 was 6.53 cu mm and after 1 month was 6.51 cu mm which was not significant after laser treatment.[14] Wróblewska - Czajka E et al, study found that YAG laser was associated with significant post laser problem like corneal oedema. The study was attempted to see the impact of laser on corneal thickness following YAG laser capsulotomy by means of OCT. Patients were examined before and one day, week, month, three months and six months after Nd: YAG capsulotomy. Statistically significant changes of central corneal thickness at one day, week, month and three months after capsulotomy were observed. Highest relative percentage change at first day (1.9%) was noted.[15]

Figure 1: [9] Representative Slit lamp photographs of human eyes with PCO.
A: Diffuse overall illumination and high magnification showing a large PCO blocking the visual axis.
B: Optical sectioning and background illumination showing that the PCO is located on the central posterior lens capsule.
C: Diffuse overall illumination and low magnification showing that the central visual axis is obscured.

3. Materials and Methods

This study included patients aged 20 - 60 years, both male and female, who had undergone cataract surgery more than three months prior and had developed posterior capsular opacification (PCO) with a best - corrected visual acuity (BCVA) of less than 20/40 or 6/9. Symptomatic visual deficits like glare and diplopia were present. Informed written consent was obtained from all participants. Exclusion criteria included patients with PCO occurring less than three months post - surgery, diabetic maculopathy, cystoid macular edema, glaucoma, age - related macular degeneration (ARMD), retinal detachment, degenerative myopia, and pre - existing corneal problems like edema, opacity, or dystrophies. Patients with physical or mental abnormalities were also excluded.

The required investigations included informed consent, slit - lamp examination, funduscopy, applanation tonometry, ultrasound B scan, and spectral domain optical coherence tomography (OCT) for pre - and post - laser measurements of central corneal and foveal thickness. Anti - glaucoma drugs (Brimonidine 0.15%) were administered before Nd: YAG laser treatment.

Sampling was done using a simple random sampling method for patients meeting the inclusion criteria. A comprehensive history and best - corrected visual acuity were recorded, followed by pupil dilation, anterior segment examination, and measurement of PCO using OCT. Intraocular pressure (IOP) was recorded, and the Nd: YAG laser was used to perform a 3.5 - 4mm capsulotomy. Measurements were repeated post - laser, and patients were followed up for 15 days.

Patient evaluation:

Patient evaluation began with obtaining informed consent using a form designed for the study, explained clearly to each patient. Best Corrected Visual Acuity (BCVA) was assessed using a Snellen's chart, with measurements taken consistently in the same room and lighting conditions. A slit lamp was used to examine the anterior segment and assess the type and extent of Posterior Capsular Opacification (PCO) after pupil dilation with Tropicamide eye drops. Intraocular pressure (IOP) was measured with a Goldmann Applanation Tonometer before the Nd: YAG laser procedure, 1 hour after, and 15 days post - procedure. An Ultrasound B - scan was performed to detect potential retinal complications, such as detachment, by applying gel on the eyelids and guiding the patient to look in different directions while the probe was applied. Spectral Domain Optical Coherence Tomography (SD - OCT) was used to measure both central corneal thickness (CCT) and foveal thickness. For CCT, the Anterior Segment acquisition protocol (512 × 128) was used, targeting a 5mm optical zone of the cornea. Foveal thickness was measured using the Macular Cube acquisition protocol (200 × 200), ensuring accurate foveal centering. A signal strength of over 7mm was required for analysis.

Before the Nd: YAG laser procedure, Brimonidine 0.15% was administered to lower IOP. Tropicamide 0.5% was instilled to dilate the pupil. The laser procedure involved delivering 4 - 5 laser bursts at 1.0 - 1.5 mJ power to achieve a capsulotomy size of 3.5 - 4mm using the Abraham lens. After the procedure, topical NSAIDs were prescribed three times a day, and an anti - glaucoma drug was administered twice a day for one week. Post - procedure evaluations, including visual acuity, IOP, CCT, and foveal thickness, were conducted one hour after capsulotomy and again 15 days later

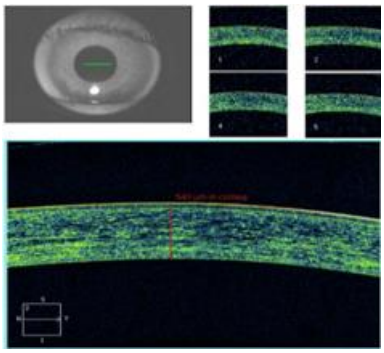

Figure 2: Anterior segment 512 x 128 OCT scan showing central cornea thickness

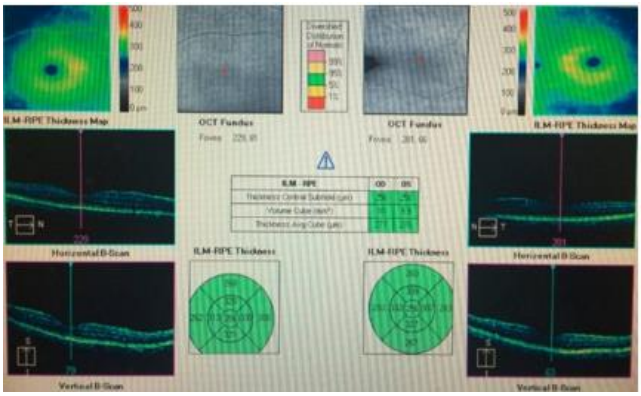

Figure 3: OCT Macular scan 200 x 200 showing foveal thickness.

4. Observations and Results

The present study titled "A study of the impact of Nd: YAG laser posterior capsulotomy on foveal thickness and central corneal thickness by using spectral domain Optical Coherence Tomography (OCT)" was conducted in VIMS & RC, Whitefield, Bangalore between January 2014 and June 2015 on the subjects who attended the outpatient department of Ophthalmology at VIMS & RC. This was a period based, observational study of 50 clinically diagnosed cases of significant posterior capsular opacification which satisfied the inclusion and exclusion criteria.

For analysis of the data patients were examined 1 hour before, 1 hour and 15 days after Nd: YAG laser capsulotomy to measure foveal thickness and central corneal thickness by using spectral domain OCT.

Statistical Methods

The Statistical analysis was performed by STATA 11.2 (College station TX USA). Shapiro wilk test for used to check the normality, Baseline data were compared 1 hour and 15 days of Intra ocular pressure, OCT foveal thickness and center corneal thickness Students t - test were used. Age category, gender distribution, Chief complaints, type of PCO, number of shots, power and capsulotomy size were described as frequency and percentage. P value of < 0.05 considered as statistically significant.

Age distribution of patients.: The total number of patients considered in this study were in the age group of 20 - 60 years.9 (18%) patients were in the age group of 20 - 45 years, 20 (40%) patients in 45 - 55 and 21 (42%) patients in the age group of 55 - 60 years. The majority of the patients are in the age group of 45 - 55 years.

Gender distribution of patients**:** Out of 50 patients 27 (54%) patients were male and 23 (46%) were females**.**

Table 1: Ocular complaints of patients

Chief complaints	Number of Cases	Percentage
Blurring of vision	28	56%
Blurring of Vision, Glare	13	26%
Blurring of vision & Diplopia	6	12%
Blurring of Vision, Glare & Diplopia	3	6%
Total	50	

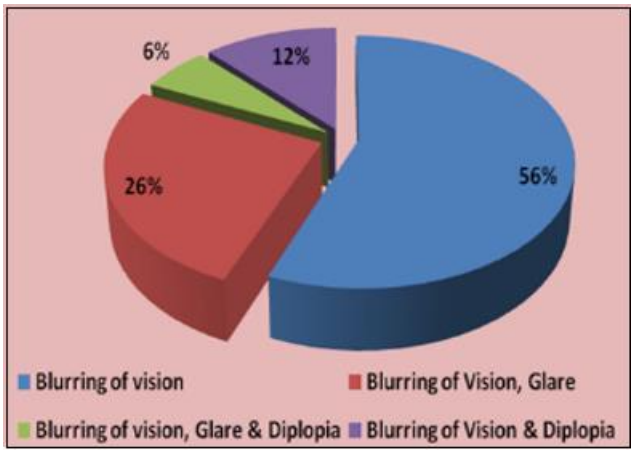

Figure 4: Ocular complaints of patients

Table no 1 and figure no 4 represents, Out of 50 patients in this study 28 (56%) patients had chief complaints of blurring of vision, 13 (26%) patients had burring of vision with glare, 6 (12%) patients had blurring of vision and diplopia and 3 (6%) patients were complaining of blurring of vision with glare and diplopia.

Table 2: Type of PCO in the study group

Type	Number of Cases	Percentage
Capsular Fibrosis	39	78%
Elschnig's Pearls	11	22%
Total	50	

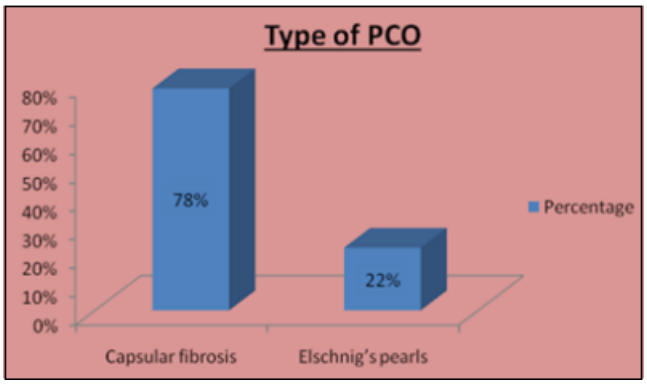

Figure 5: Type of PCO in the study group

Table no 2 and figure no 5 represents in this study group capsular fibrosis was observed in 39 patients (78%) and Elschnig's pearls in 11 patients (22%).

Table 3: BCVA of patients studied

BCVA	Baseline	1 Hour	15 Days
>6/60	9 (18%)	Nil	Nil
6/60	6 (12%)	8 (16%)	Nil
6/36	15 (30%)	4 (8%)	Nil
6/24	10 (20%)	13 (26%)	5 (10%)
6/18	7 (14%)	17 (34%)	13 (26%)
6/12	3 (6%)	8 (16%)	17 (34%)
6/9	Nil	Nil	11 (22%)
6/6	Nil	Nil	4 (8%)
Total	50	50	50

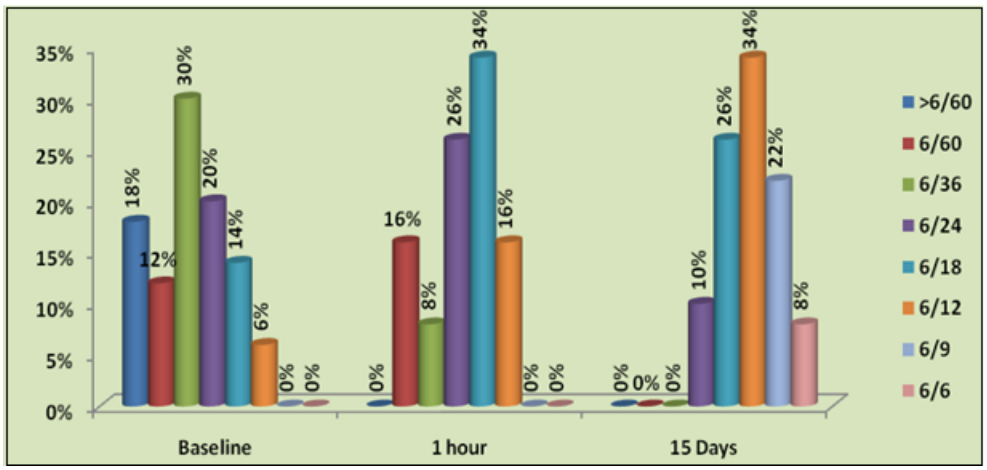

Figure 6: Bar graph of BCVA before 1 hour and 15 days after Nd: YAG capsulotomy

BCVA one hour before capsulotomy, one hour after and 15 days later capsulotomy. As per Table No 3 and graph no 6 represent BCVA one hour and 15 days later post capsulotomy was improved from baseline BCVA to 2 - 4 lines (Snellen's chart).

Table 4: Capsulotomy size

Capsulotomy Size	Number of Cases	Percentage
3.0	1	2%
3.5	23	46%
4.0	26	52%
Total	50	

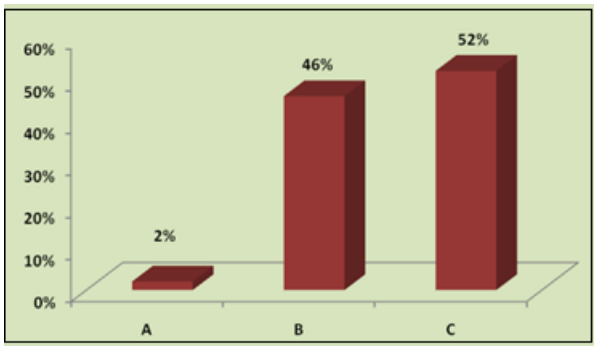

Figure 7: Capsulotomy size

Capsulotomy was performed with Nd: YAG laser using 1.0 - 1.5 mj power with 4 - 5 laser shots achieving 3.5 - 4 mm capsulotomy size. Table No 4 and graph no 7 represents Capsulotomy opening of 3 mm was made in 1 patient (2%), 3.5mm in 23 patients (46%) and 4mm in 26 number of patients (52%).

Table 5: Showing IOP changes from baseline at 1 hour and 15 days after capsulotomy

Intra Ocular pressure	Mean ± SD	Min - Max	P - Value
Baseline	13.2 ± 2.18	10 – 18	
1 hour	17.48 ± 3.25	12 - 24	<0.001
15 Days	13.0 ± 1.29	10 - 16	0.417

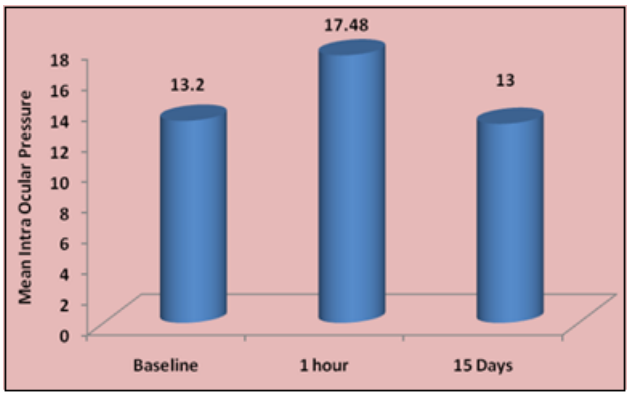

Figure 8: Bar graph showing mean IOP

Table No 5 and graph no 8 represents measurement of intraocular pressure one hour before capsulotomy, one hour after and 15 days later capsulotomy. Baseline mean IOP is (13.2 ± 2.18), one hour after capsulotomy mean IOP (17.48 ± 3.25) and 15 days later capsulotomy (13.0 ± 1.29). Elevation of IOP by 2 - 6 mmHg was observed one hour after capsulotomy when compared to baseline IOP.

OCT Foveal thickness—1 hour before, 1 hour and 15 days after capsulotomy.

Table 6: Thickness central subfield of macula

Thickness central subfield	Mean ± SD	Min - Max	P - Value
Baseline	238.92 ± 38.77	162 - 298	
1 hour	242.08 ± 41.06	162 - 318	0.142
15 Days	239.96 ± 36.54	162 - 298	0.663

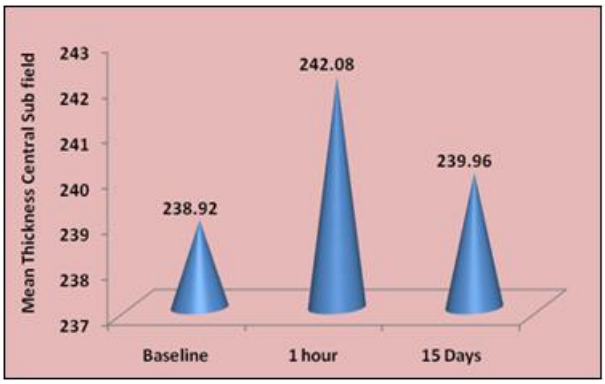

Figure 9: Graph showing mean thickness central subfield of macula

Table No 6 and graph no 9 represents mean thickness of central subfield of macula one hour before capsulotomy, one hour after and 15 days later capsulotomy. Baseline thickness central subfield of macula is (13.0 ± 1.29), one hour after capsulotomy (242.08 ± 41.06) and 15 days later capsulotomy (239.96 ± 36.54).

Table 7: Volume cube

Volume cube	Mean ± SD	Min – Max	P - Value
Baseline	8.44 ± 1.10	5.9 – 10.6	
1 hour	8.45 ± 1.09	5.9 – 10.6	0.792
15 Days	8.44 ± 1.09	6.0 10.2	0.944

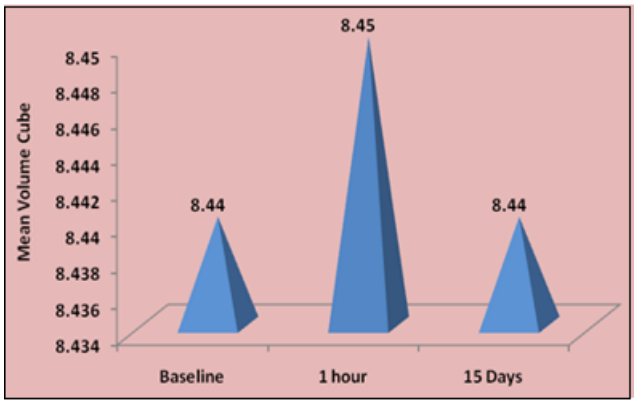

Figure 10: Graph showing mean volume cube

Table No 7 and graph no 10 represents mean volume cube of macula showing baseline mean volume cube as (8.44 ± 1.10), one hour after capsulotomy (8.45 ± 1.09) and 15 days later capsulotomy (8.44 ± 1.09).

Table 8: Thickness average cube.

Thickness average cube	Mean ± SD	Min - Max	P - Value
Baseline	210.4 ± 44.95	122 – 329	
1 hour	209.8 ± 41.68	122 – 296	0.687
15 Days	209.26 ± 40.65	128 - 298	0.490

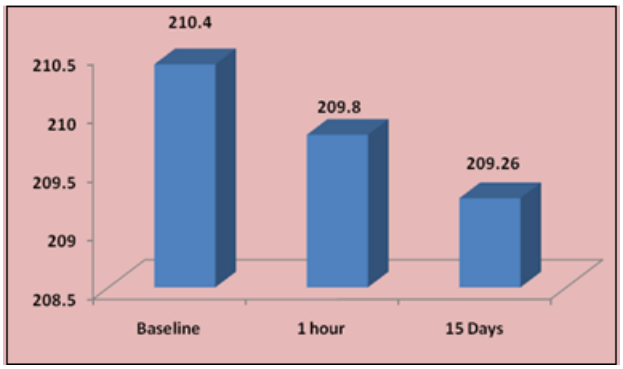

Figure 11: Graph showing thickness average cube

Table No 8 and graph no 11 represents thickness average cube of macula showing baseline mean thickness average cube as (210.4 ± 44.95), one hour after capsulotomy (209.8 ± 41.68) and 15 days later capsulotomy (209.26 ± 40.65).

Table 9: Showing central corneal thickness 1 hour before, one hour and 15 days after capsulotomy.

Central corneal thickness	Mean ± SD	Min - Max	P - Value
Baseline	530.72 ± 18.97	501 - 580	
1 hour	540.58 ± 28.96	501 - 608	0.001
15 Days	531.1 ±19.39	501 - 580	0.399

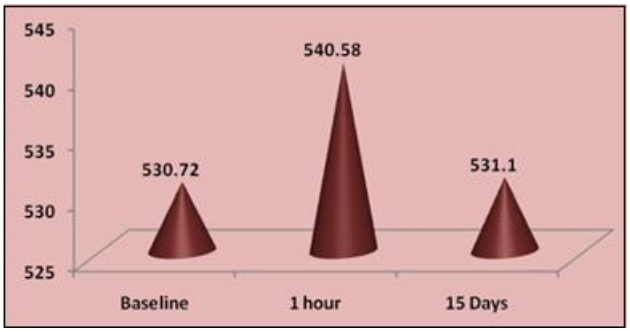

Figure 12: Graph showing central corneal thickness

Table No 9 and graph no 12 represents measurement of central corneal thickness one hour before capsulotomy, one hour after and 15 days later capsulotomy. Baseline mean central corneal thickness is (530.72 ± 18.97), one hour post capsulotomy (540.58 ± 28.96) and 15 days later capsulotomy (531.1 ±19.39).

5. Discussions

Nd: YAG laser posterior capsulotomy is a frequently performed procedure after ECCE surgery because PCO is the most common complication after cataract surgery and more common in children and younger adults although the latest techniques of cataract surgery are being used.

In the study of 320 cases the time interval between cataract surgery and Nd: YAG laser posterior capsulotomy was 2.5 years (range 1 to 4 years), while it was reported as 2.49 year by Hasan KS, et al.[16] Nd: YAG laser capsulotomy is safe, effective and non invasive procedure but not free from complications. Posterior capsule opacification is the most common delayed complication of cataract surgery and is mostly treated with non invasive Nd: YAG capsulotomy.

In this study, an attempt has been made to study the effects of Nd: YAG capsulotomy on foveal thickness and central corneal thickness using spectral domain OCT and to observed the predominant type of PCO in the study group.

50 cataract postoperative patients 27 males (54%) and 23 females (46%) with clinically significant PCO, which satisfied the inclusion and exclusion criteria were included in this study. Patient's chief complaints were varied from blurring of vision, glare and diplopia.

BCVA was noted before, one hour and 15 days after post capsulotomy, which was improved from baseline BCVA to 2 - 4 lines (Snellen's chart) which was clinically significant improvement.

According to Mohammad Younas Khan et al, the capsular fibrosis type of PCO was found in 36% of cases, Elschnig's pearls was found in 12% and 9% had capsular wrinkling.[12]

The relative incidence of different types of PCO showed that the capsular fibrosis was the predominant type of PCO as compared to Hasan et al study, who reported elschnig pearls in pseudophakic eyes and secondary fibrosis in aphakic eyes as the predominant type encountered.[13]

In this study we found that capsular fibrosis is the most predominant type of PCO which accounts for 78% followed by elschnig's pearls which found out to be 22%.

The most common complication of Nd: YAG capsulotomy is the elevation of IOP, although usually transient. Different explanations which have been given for the pressure rise following Nd: YAG laser treatment include the deposition of debris in the trabecular meshwork, [17] pupillary block, [18] and inflammatory swelling of the ciliary body or iris root associated with angle closure[19]. Despite the prophylactic treatment, increased IOP was reported in 15% to 30% of patients in several studies.2[0] Keates et al. found elevation of IOP in 6% of his patients, whereas Stark et al. reported that the elevation of IOP was 1.0% after Nd: YAG capsulotomy.[21, 22] Ge et al. found that rise in IOP was more pronounced in patients with glaucoma in those who experienced a higher rise of IOP within hour of capsulotomy.[23] However, 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.2[4] Ari et al. also did not find any persistent rise in IOP.8 In our study, elevation of IOP observed was from 2 - 6 mmHg one hour after post capsulotomy in 9 patients (17.48 ± 3.25), which was statistically significant when compared to baseline (13.2 ± 2.18). All of these patients were given 0.15% Brimonidine 2 times a day for 1 week. After capsulotomy, IOP level of all these patients was recorded normal in 15 days follow up. In our patients it was observed that the elevation of IOP was very low because we used low energy level and less number of pulses for capsulotomy.

Pitting of IOL is another complication of Nd: YAG capsulotomy. Keates et al reported Pitting of IOLs in 15 - 33% of eyes during Nd: YAG laser posterior capsulotomy.[21]

We found pitting of IOL in less than 5% of our patients and was not visually significant.

One of the serious complications of Nd: YAG laser capsulotomy is that it leads to cystoid macular edema. Raza reported cystoid macular edema in 3% of 550 patients treated with Nd: YAG laser capsulotomy for pseudophakic and aphakic posterior capsule opacification.[25] Haris WS noted 16 eyes (4.4%) out of 342 eyes with cystoids macular edema. In such cases the possible mechanism of CME is still unclear but it is suggested that in response to YAG laser the prostaglandin released from anterior segment and reached the retina through vitreous that alters the permeability of paramacular capillaries to develop CME. Continuous iris irritation by displaced vitreous in AC around the pupil margin may promote CME. Delay in Nd: YAG laser capsulotomy by 90 days after cataract surgery allows full recovery of the blood aqueous barrier and can reduce the rate of cystoids macular edema.

Ari et al. evaluated how different energy levels of Nd: YAG laser capsulotomy affect macular thickness.8 They divided patients into two groups based on the energy levels used in Nd: YAG laser. They found that both groups had increased macular thickness compared to preoperative levels; macular thickness measurements of the patients treated with high energy levels were significantly higher compared to low energy levels.

In our study, energy levels of 1 - 1.5 mj were used to make 3 - 4mm of capsulotomy size with 4 - 5 number of shots. We found increase in macular thickness in 2 patients which was not statistically significant. Mean foveal thickness was found to be not statistically significant at 1 hour and 15 days after post capsulotomy.

Wróblewska - Czajka E et al, study was attempted to see the impact of laser on corneal thickness following YAG laser capsulotomy by means of OCT before and one day, week, month, three months and six months after Nd: YAG capsulotomy where they found statistically significant changes of central corneal thickness at one day, week, month and three months after capsulotomy. Highest relative percentage change at first day (1.9%) was noted.[15]

In our study changes in central corneal thickness was observed at one hour after Nd: YAG capsulotomy which was (540.58 ± 28.96) when compared to baseline CCT (530.72 ± 18.97) and was statistically significant.

Retinal detachment is another serious complication after Nd: YAG laser capsulotomy. Raza reported 11 patients (2%) of retinal detachment after Nd: YAG laser capsulotomy.2[5] Steinert et al. reported that eight patients of 897 patients treated with Nd: YAG laser posterior capsulotomy developed retinal detachment. Presentations such as vitreous syneresis, posterior vitreous detachment and retinal tears also have been described after posterior capsulotomy. The follow - up period of 15 days did not enable the assessment of long - term changes after the procedure. Prospective studies assessing the effect of posterior capsulotomy on vitreous degeneration are necessary to understand the role played by this procedure in vitreoretinal complications.

The results of this study must be regarded taking into account its limitations. The sample comprises a limited number of patients without ocular diseases apart from cataracts and PCO. Accordingly, said results might not be applicable in patients with ocular disease. Prospective studies are necessary to assess the safety of posterior capsulotomy with Nd: YAG laser in patients with ocular disease. However, significant changes in IOP, central corneal thickness one hour after capsulotomy was found. Despite said limitations, the results of this study suggest that posterior capsulotomy with Nd: YAG laser is a safe and non - invasive procedure for posterior capsular opacification. Energy levels of 1 - 1.5 mj with 4 - 5 number of shots with 3 - 4mm of capsulotomy size is a safe for capsulotomy procedure since there has been no change in the foveal thickness with expected BCVA improvement post capsulotomy.

Further studies need to be done to asses the effects of Nd: YAG laser capsulotomy where higher energy and number of pulses are necessary on thicker PCO as an alternative to the invasive surgical capsulotomy which is recommended in such situations.

6. Conclusions

Despite advances that have increased the success and safety of cataract surgery in recent years, posterior capsule opacification remains a common complication.

The only effective and non - invasive treatment of PCO is Nd: YAG laser capsulotomy which is not free of complications. In this study 50 patients with clinically significant PCO were analyzed which satisfied the inclusion and exclusion criteria.

Based on the observation and analysis of data, it has been found that, capsular fibrosis is the most predominant type of PCO which accounts for 78% followed by elschnig's pearls which found out to be 22%.

Clinically significant BCVA improvement from 2 - 3 lines (Snellen's chart) was observed at 1 hour and 15 days after capsulotomy compared to baseline BCVA.

Complication like elevation of IOP which was found out to be from 2 - 6 mmHg one hour after post capsulotomy in 9 patients (17.48 ± 3.25), which was statistically significant when compared to baseline (13.2 ± 2.18). All of these patients were given 0.15% Brimonidine 2 times a day for 1 week. After capsulotomy, IOP level of all these patients were recorded normal in 15 days follow up.

Effect on central corneal thickness was observed at one hour after Nd: YAG capsulotomy which was (540.58 ± 28.96) when compared to baseline CCT (530.72 ± 18.97) and was statistically significant.

There were no significant changes on foveal thickness at 1 hour and 15 days follow up.

This study shows that Nd: YAG capsulotomy is an effective treatment to improve the hindered vision by PCO since there are no changes in the foveal thickness but associated with unavoidable complications like increase in IOP and central corneal thickness. So, it is safe to be aware of the collateral reversible damage to ocular tissues following Nd: YAG laser capsulotomy so preventive measures can be implemented. It is also suggested that energy level should be kept to a minimum level to avoid severe complications.

7. Future Scope

Future research on Nd: YAG laser capsulotomy could benefit from larger, more diverse sample sizes, incorporating patients with a variety of ocular conditions beyond PCO. This would enable a broader understanding of how pre - existing ocular diseases might affect outcomes such as IOP, central corneal thickness (CCT), and foveal thickness, compared to the relatively healthy patient population studied here.

Additionally, extending follow - up periods beyond 15 days would offer valuable insights into the long - term effects of the procedure, particularly concerning complications such as cystoid macular edema (CME) and retinal detachment. Since these complications may arise weeks or months post - capsulotomy, prolonged observation would be critical for assessing the full spectrum of risks. Incorporating advanced imaging techniques, like spectral - domain OCT, could further enhance the evaluation of macular thickness and retinal changes over time.

Benefits Compared to Historical Studies

Energy Efficiency and Safety: This study used relatively low energy levels (1 - 1.5 mJ), which demonstrated a lower incidence of complications like increased IOP compared to earlier studies that reported higher complication rates with greater energy levels. This reflects an important evolution in the safety of the procedure, as more conservative energy settings minimize collateral damage to ocular tissues.

Significant BCVA Improvement: The documented improvement in best - corrected visual acuity (BCVA) in 2 - 3 lines on the Snellen chart is consistent with historical studies but highlights the predictability and reliability of Nd: YAG laser capsulotomy as an effective treatment for PCO.

Insight into Central Corneal Thickness (CCT): This study adds novel insights into the short - term effects on CCT, a parameter not routinely emphasized in older studies. The observation of a transient yet statistically significant increase in CCT provides a more complete picture of the procedure's impact on anterior segment structures.

Limitations Compared to Historical Studies

Limited Follow - up for Long - term Complications: While historical studies have observed complications like retinal detachment and CME in larger sample sizes and over longer follow - up periods, this study's relatively short - term follow - up limits the ability to fully assess such risks. Some historical studies have reported these complications several weeks or months post - procedure, an aspect not captured in this research.

Absence of Data on Special Populations: Historical studies have occasionally included patients with glaucoma or other pre - existing ocular diseases, providing a wider range of outcomes. In contrast, this study's exclusion criteria led to a relatively homogenous population. Expanding future research to include special populations, such as those with pre - existing glaucoma or high myopia, would offer more generalizable results.

8. Areas for Future Research

Comparison of Different Energy Levels: Future research could investigate outcomes with varying energy levels to optimize the balance between efficacy and safety, especially for cases with thicker or more resistant PCO, which may require higher energy.

Preventive Approaches for Complications: Exploring prophylactic treatments aimed at reducing complications like IOP elevation or CME, such as different dosing regimens of anti - inflammatory or IOP - lowering medications, could help mitigate risks for certain patient populations.

Technological Innovations: Investigating how emerging laser technologies or refinements in current Nd: YAG laser devices might further reduce risks, improve outcomes, and potentially lower the required energy levels for capsulotomy could represent a critical area for development.

In summary, while this study contributes valuable data on the short - term efficacy and safety of Nd: YAG laser capsulotomy, future studies could focus on more diverse patient groups, longer follow - up periods, and preventative strategies to further reduce complications. These steps will refine our understanding and application of the procedure and help develop even safer and more effective treatments for PCO.

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