YAG capsulotomy rates between two types of trifocal intraocular lenses

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Abstract

Objective: To evaluate YAG capsulotomy rates following implantation of two types of trifocal intraocular lenses (IOLs).

Methods: In this retrospective cohort study consecutive patients who underwent cataract surgery with a trifocal IOL from 1st May 2017 to 30th October 2019 at Aga Khan University Hospital, Karachi were included. Eyes which either had an AT Lisa Tri or Alcon PanOptix IOL implant were included. The primary outcome measure was Nd: YAG laser. Univariate analysis of all predictor variables was performed followed by a multivariate regression analysis of those which were significant. A p-value of < 0.05 was taken as significant.

Results: A total of 328 eligible eyes were identified. Nine eyes were excluded. Out of the 319 eyes of 177 patients included in this study, 180 received AT Lisa Tri while 139 of them received Alcon PanOptix Trifocal IOLs.

The mean (SD) age of the patients was 52.29 years (±11.04). Gender was equally distributed with 91(51.4%). male patients. Median (IQR) time to laser capsulotomy was 8 months (3-16). Clinically posterior capsular opacification (PCO) was present in 75(23.5%) eyes. A total of 39(12.2%) eyes underwent Nd: YAG laser capsulotomy. Among the AT Lisa Tri group 29 (16.1%) eyes underwent laser capsulotomy compared to 10 (7.2%) (n=10) in Alcon PanOptix group (p=0.016). In both univariate and multivariate analyses, gender and IOL type were statistically significant.

Conclusion: Eyes implanted with AT Lisa Tri showed a significantly increased rate of YAG capsulotomy. A prospective randomized control trial is recommended to confirm these findings.

Keywords: Trifocal IOL, Posterior capsular opacification, Post-Operative Complications, Lens Implantation.
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Introduction

Phacoemulsification cataract surgery with an intra-ocular lens (IOL) implant is one of the most commonly performed surgical procedures. As the safety of cataract surgery is improving, the emphasis is now on improved refractive outcomes and spectacle independence.[1] Presbyopia correcting IOLs, such as trifocal IOLs, provide spectacle independence for distance, intermediate, and near vision. The implantation of presbyopia-correcting IOLs is progressively increasing.[2]

Posterior capsular opacification (PCO) is known to occur in some patients following uncomplicated cataract surgery. PCO reduces the quality of vision by reducing contrast sensitivity or by causing glare. While many studies evaluate patient satisfaction or quality of vision after trifocal IOLs, very few studies specifically look at the incidence of PCO, and the need for Nd:YAG (neodymium-doped yttrium aluminium garnet) laser after trifocal IOL implants. Due to the diffractive rings, patients with presbyopia-correcting IOLs are more sensitive to residual cylindrical errors, and PCO.[3-5] PCO is treated by Nd:YAG laser capsulotomy. Laser capsulotomy is associated with the risk of certain complications such as cystoid macular oedema and rhegmatogenous retinal detachment (RRD). RRD is thought to occur at an increased rate after YAG capsulotomy.[6] Gap in the posterior capsule allows fluid from liquified vitreous to flow anteriorly, initiating the collapse of the vitreous gel and posterior vitreous detachment (PVD). PVD may cause retinal tears which, if untreated, can lead to RRD.[7]

The aim of this study is to compare Nd:YAG laser capsulotomy rates following implantation of two different types of trifocal IOLs in a tertiary care hospital in Karachi, Pakistan.

Patients and Methods

This is a retrospective cohort study. Medical charts of consecutive patients who underwent phacoemulsification cataract surgery with trifocal IOLs from 1st May 2017 to 30th October 2019, at the Aga Khan University Hospital (AKUH), Karachi Pakistan were reviewed. Potential patients were identified from the medical billing and coding system of the hospital. The medical charts were reviewed between 20th February 2020 till 15th March 2020. Patients with missing files were excluded.

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A standard small incision phacoemulsification cataract surgery was performed in all cases. Surgeries were performed by eight experienced faculty members. Corneal incision size varied between 2.2mm and 2.4mm. A dispersive viscoelastic agent (Viscoat, Alcon, TX) was used to protect the corneal epithelium. Cohesive viscoelastic (Provisc, Alcon, TX) was used to fill the anterior chamber. Central curvilinear capsulorhexis, nucleus disassembly, and phacoemulsification was performed by the surgeon's preferred method. After aspiration of the remaining soft lens matter, cohesive viscoelastic was injected to reform the anterior chamber. IOL was implanted in the bag with the help of an injector. Viscoelastic was removed and the corneal wound was hydrated. Patients were put on intense moxifloxacin and dexamethasone/ prednisolone eye drops initially and then tapered gradually over the next 4-6 weeks. Nepafenac eye drops were also given postoperatively.

The primary outcome measure in this study was Nd:YAG laser capsulotomy. Surgeon's notes in the patient's file coupled with the medical billing and coding system of the hospital identified patients who underwent Nd:YAG laser capsulotomy. Subgroup analysis for conditions known to cause increased PCO, such as diabetes and high myopia (defined as -6D or less), was also performed. The data was analyzed using SPSS version 23. Descriptive statistics are reported for quantitative variables by mean (± SD). Normality was assessed by the Kolmogorov-Smirnov test. The qualitative variables are being reported as frequency and percentages and were assessed by the chi-squared test. We used logistic regression to determine the relationship between most important predictors for YAG laser treatment. We conducted univariate analyses for all variables and included them into a multivariate model. A p-value of 0.05 or less was considered statistically significant.

An ethical exemption was obtained for this study from the Ethical Review Committee, AKUH (ERC# 2020-3502-8646). This study was conducted in accordance with the tenets of the Declaration of Helsinki.

Results

A total of 328 eligible eyes were identified. Nine eyes were excluded due to incorrect procedure code, or missing files. Out of the 319 eyes of 177 patients included in this study, 180 received AT Lisa Tri while 139 received Alcon PanOptix trifocal IOLs (Figure-1).

The mean age of the patients was 52.29 years (±11.04). Gender was equally distributed with 91(51.4%) male patients. There were 39 (22%) patients having diabetes,

Table-1: Baseline characteristic of study population (N=319).

No	Variable	All patients	AT Lisa N=180	PanOptix N=139	P-value
1	Number of eyes	319	180 (56.4%)	139 (43.6%)	-
2	Age (years)	52.29 (±11.04)	50.1 (±11.40)	55.13 (±9.89)	<0.001
3	Gender				
	Male	162 (50.8%)	88 (48.9%)	74 (53.2%)	0.441
	Female	157 (49.2%)	92 (51.1%)	65 (46.8%)	0.441
4	Diabetes	70 (21.9%)	19 (10.6%)	51 (36.6%)	<0.001
5	Axial Length (mm)	23.90 (±1.54)	24.16 (±1.73)	23.57 (±1.18)	0.03
6	High Myopia	32 (10%)	23 (12.8%)	9 (6.5%)	0.063
7	Toric Version	56 (17.6%)	25 (13.9%)	31 (22.3%)	0.05

*Column Percentages were used & only yes category has been reported.

Table-2: Factors affecting YAG laser capsulotomy rates.

	Univariate Analyses			Multivariate Analyses		
Variables	β	OR (95% CI)	P-value	β	OR (95% CI)	P-value
Gender	1.092	2.980 (1.427 ? 6.220)	0.004	-0.943	0.389 (0.181 ? 0.836)	0.015
Age	0.718	2.050 (0.826 ? 5.087)	0.122	0.322	1.380 (0.472 ? 4.030)	0.556
IOL Type	0.907	2.477 (1.163 ? 5.277)	0.019	0.722	2.058 (0.882 ? 4.803)	0.095
Simple vs Toric IOL	0.179	1.196 (0.476 ? 0.3006)	0.704	0.153	1.165 (0.432 ? 3.144)	0.763
Diabetes	0.097	1.102 (0.482 ? 2.519)	0.818	-1.518	0.219 (0.044 ? 1.103)	0.066
High Myopia	0.574	1.776 (0.681 ? 4.634)	0.24	0.567	1.763 (0.529 ? 5.880)	0.356
Axial length	-0.461	0.630 (0.131 ? 3.034)	0.565	0.672	1.959 (0.287 ? 13.35)	0.492
Cataract Type	-0.189	0.828 (0.232 ? 2.950)	0.77	-0.303	0.739 (0.185 ? 2.949)	0.668

* β: Unstandardized Beta Coefficient; OR: Odds Ratio; 95% CI: Confidence Interval.

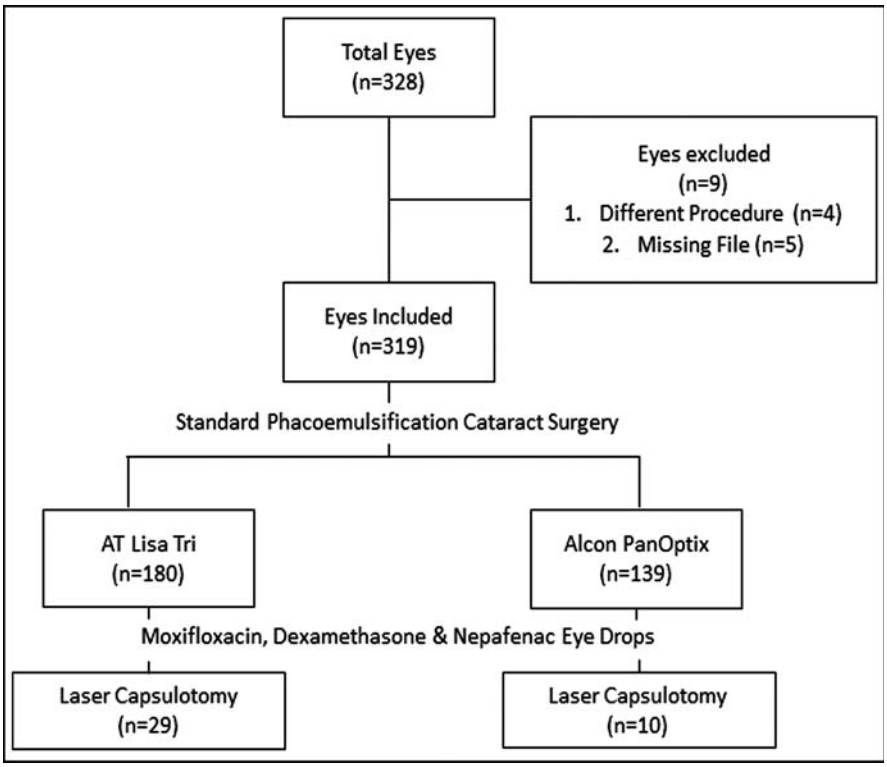

Figure-1: Overview of study population.

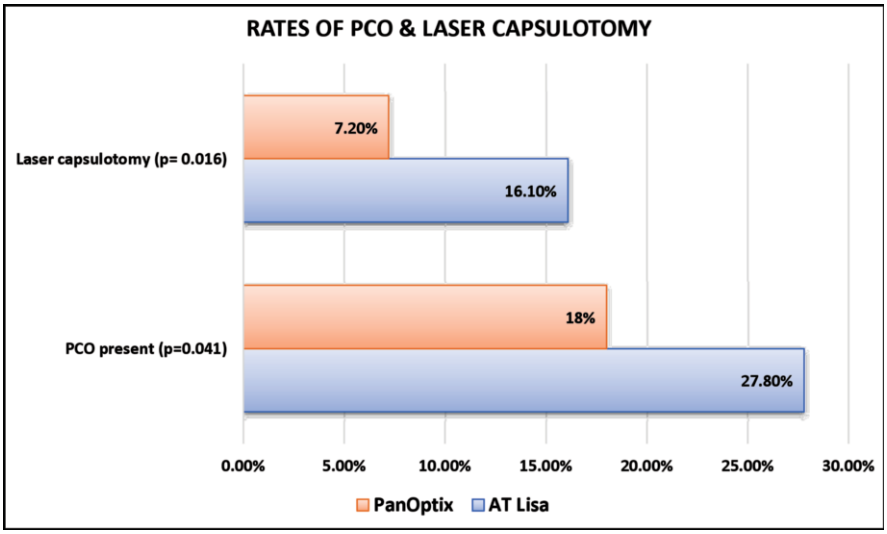

Figure-2: Clinical PCO and YAG capsulotomy rates between AT Lisa & PanOptix.

however none of them had diabetic maculopathy. The average axial length of the 319 eyes included in this study was 23.9 mm (±1.54). High myopia was present in 32 eyes (10%) (Table-1).

The Toric version of a trifocal lens was implanted in 56 eyes (17.6%). Clinically PCO was present in 75 eyes (23.5%) whereas Nd:YAG laser capsulotomy was done in 39 eyes (12.2%). Median (IQR) time to laser capsulotomy was 8 months (3-16). In this study, 29 eyes (16.1%) in the AT Lisa group underwent laser capsulotomy while 10 eyes (7.2%) which received Alcon PanOptix Trifocal IOL got laser capsulotomy done for PCO (p=0.016). This was statistically significant (Figure-2).

Descriptive subgroup analysis of YAG capsulotomy rates in diabetic and high myopic eyes was performed. In the diabetic subgroup YAG laser capsulotomy was performed in 4 out of 19 eyes (21%) with AT Lisa Tri and 4 out of 51 eyes (7.8%) with Alcon PanOptix. In the high myopic subgroup YAG capsulotomy was done in 5 out of 23 eyes (21.7%) with AT Lisa Tri and 1 out of 9 eyes (11.1%) with Alcon PanOptix. In Univariate analyses gender and IOL type were significant (p-value <0.05). In multivariate regression analyses both variables remained significant with a p-value of 0.015 and 0.095 respectively (Table-2).

Discussion

The higher rates of PCO in eyes implanted with AT Lisa Tri in our study is consistent with previously reported findings in the literature. Bilbao et al.[8] evaluated YAG capsulotomy rates among AT Lisa tri 839MP IOL and FineVision MicroF IOLs. They reported higher YAG capsulotomy rates in eyes injected with AT Lisa tri 839MP IOL compared to FineVision MicroF IOL (23% vs 9%) during the first year after implantation (P<0.001). This difference can be explained by the different designs of both IOLs. Studies on plate-haptic design, a characteristic of AT Lisa, have mixed views with some associating it with an increased PCO and YAG capsulotomy rates.[9,10] While other studies considered PCO rates, optical quality and rotational stability of plate haptic IOLs comparable with loop haptics.[11-13]

The material of an IOL plays an important role in inhibiting PCO development. AcrySof IOLs are hydrophobic IOLs with sharp optic edges that have shown favourable outcomes in reducing PCO development.[14-16] AcrySof IOLs (Alcon Laboratories, Inc.)

has been shown to have increased attachment to the proteins-fibronectin and laminin due to its acrylic material resulting in better binding to the capsule.[17] Additionally, its sharp optic edges creates a capsular bend which restricts the movement of the lens epithelial cells and hence prevents PCO formation.[15,16,18] Due to the bioactivity of the AcrySof material a single layer of the lens epithelial cells, posterior capsule, and the IOL join together in a sandwich pattern thus inhibiting PCO formation.[17,19]

Eyes with monofocal AcrySof IOLs showed a lower risk of Nd:YAG capsulotomy (Hazard Ratio: 2.68; 95% Credible Interval: 1.41, 4.77; $p < 0.01$) in comparison with non-AcrySof hydrophobic or hydrophilic IOLs [hydrophilic acrylic (Hazard Ratio: 7.54; 95% Credible Interval: 4.24,14.06; $p < 0.001$), PMMA (Hazard Ratio: 3.64, 95% Credible Interval: 1.87, 6.33; $p < 0.001$), and silicone (Hazard Ratio: 1.13;95% Credible Interval: 0.59, 1.91; $p < 0.1$) IOLs] in a study by Thom et al.[20] Similarly, Ursell et. al. have reported that Nd:YAG capsulotomy and incidence of PCO is significantly lesser in monofocal AcrySof IOLs [2.4% (2.2-2.7)] in comparison with other hydrophilic [10.9% (10.5-11.3)] and hydrophobic acrylic IOLs [4.4% (4.1-4.7)] at 3 years following IOL implantation (95% CI).[21] In their study the 3-year Nd:YAG capsulotomy incidence for AcrySof was approximately two folds lower than non-AcrySof hydrophobic IOLs and approximately four-times lower than hydrophilic IOLs. Reasons for lower PCO rates for PanOptix IOLs include material and design aspects. PanOptix IOLs are made of AcrySof material and do not have a plate haptic design.

In our study cohort, the eyes of diabetic and high myopic patients had higher YAG capsulotomy rates (Table-2). However, due to small numbers, and unequal distribution of these variables among the two IOL groups, it was not possible to draw any concrete conclusions. Because our study was not sufficiently powered to evaluate the differences between the sub-groups, caution is recommended when interpreting these findings. A larger prospective study is required to evaluate clinical significance of trends identified in our study. Female gender was associated with higher YAG capsulotomy rates which is consistent with the literature.[22]

The development of PCO is a significant concern for patients and their healthcare providers. The development of visually significant PCO warrants an additional procedure, and its development in trifocal IOLs is even more problematic. This is because the total quantity of light rays entering the eyes are distributed between distance, intermediate and near distances. PCO further reduces the quantity of light, with resulting reduction in quality of vision; contrast sensitivity and visual acuity. Elgohray et al observed the effect of PCO and its resulting reduction in vision in multifocal IOL as compared to monofocal IOL.[3] They reported that the multifocal group were affected earlier than the monofocal group. Similar findings have been reported by other authors.[4] In a comparator study of AcryS of multifocal and monofocal IOLs it was found that after a mean follow up of 22-months (range: 2 to 41 months), 22 (15.49%) eyes in the multifocal group underwent posterior capsulotomy compared with 16 (5.82%) eyes in the monofocal group ($p = 0.0014$).

Visually significant PCO is treated by Nd:YAG laser capsulotomy. Although this is an outpatient procedure performed in an office setting,. Nd:YAG laser capsulotomy carries risks of complications including sight threatening complications like cystoid macular oedema and RRD. An increased risk of RRD in the five months following laser capsulotomy was reported by Wesolosky et. al. with the rate of retinal tear being 0.29% and the rate of RRD being 0 .87%. The risk returned to the baseline after 5 months.[6] Interference with the anterior vitreous face, intraocular lens pitting, transiently raised IOP and mild anterior uveitis were some other complications following Nd: YAG laser posterior capsulotomy.[23] Therefore, presbyopia-correcting IOLs with lower PCO rates would be preferable.

In our study Nd:YAG laser capsulotomy was used as the primary outcome measure. A clinical scoring system to evaluate the development of PCO may have been considered a more objective assessment method. However, real-world patients show variable sensitivity to the same amount of PCO, probably depending on its location, type, and extent. Therefore, employing an objective scoring method may not truly reflect the adverse visual effects of the PCO. Other authors have also used Nd:YAG laser capsulotomy as the primary outcome measure to assess visually significant PCO.[8,23,24]

Limitations of our study include the retrospective nature of the study and subjective criteria for YAG capsulotomy. In our study, laser capsulotomy was performed by eight ophthalmologists in our department. Indication for laser capsulotomy was a visually significant PCO affecting patients' quality of vision. This criterion is subjective and may have been different for different surgeons. However, it is a pragmatic criterion and was the same for both IOL groups. Another limitation in the study is the possibility that some patients who underwent phacoemulsification at our hospital might have had Nd:YAG capsulotomy done elsewhere. However, it is expected that these limitations would have been randomly distributed

between the two groups.

Conclusion

In our study cohort patients who were implanted with an AT Lisa tri IOL showed an increased rate of YAG capsulotomy. We propose a prospective randomized controlled trial to confirm these findings.

Disclaimer: None to declare.

Conflict of Interest: None to declare.

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