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Assessment of Endothelial Cell Count Changes Post-Yttrium Aluminium Garnet Laser for Posterior Capsular Opacification

Amna khan, Abdul Rauf, Muhammad Haroon Sarfraz, Summaya Khan, Taimoor Ashraf, Nazia Iqbal

Department of Ophthalmology, Armed Forces Institute of Ophthalmology/National University of Medical Sciences (NUMS) Rawalpindi Pakistan

ABSTRACT

Objective: The study aimed to assess the effect of Neodymium : Yttrium Aluminium Garnet laser (ND:YAG laser) on endothelial cell count loss and anterior segment elements.

Study Design: Quasi-experimental.

Place and Duration Of Study: Armed Forces Institute of Ophthalmology, Rawalpindi from Jul 2021 to Feb 2022.

Methodology: A total of 60 patients with a history of posterior capsular opacities planned for Neodymium: Yttrium Aluminium Garnet laser posterior capsulotomy were included. Specular microscopy was done pre and post-laser to study and parameters such as central corneal thickness, endothelial cell count, intra-ocular pressure was noted. Data were analyzed by using the Statistical Package for the Social Sciences version 23 software

Result: After four weeks of Neodymium : Yttrium Aluminium Garnet laser, there was no significant change in the intraocular pressure (p=0.334), however, the visual acuity improved from 0.6±0.3-0.05±0.1 (p<0.001) along with a decrease in endothelial cell count 2101±485-1919±427 (p<0.001) and central corneal thickness 0.504±0.03-0.502± 0.03 (p=0.010). A similar trend of changes in the parameters was observed for lower (1.0-1.2MJ) and higher energy (2.1-2.5MJ) in the sample for posterior capsulotomy.

Conclusion: Our study concluded that the corneal structural changes occur post-Neodymium: Yttrium Aluminium Garnet posterior capsulotomy, including changes in endothelial cell count. However, there is no significant disturbance in the intraocular pressure after the procedure.

Keywords: Capsulotomy, Endothelial cell count ND, Specular microscopy, Yttrium aluminium garnet laser.

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INTRODUCTION

Posterior capsular opacity (PCO) is one of the vision-threatening conditions, which develop as a late complication after cataract surgery. Many factors increase the risk towards the development of the condition such as the intraocularlens type, the systemic conditions a patient might be facing, or the decreased opening of the continuous curvilinear capsulorhexis. It may lead to loss of vision, loss of contrast sensitivity, & development of glare and reflection. However, it is a treatable situation, due to the use of Neodymium Yttrium Aluminium Garnet (Nd: YAG) laser capsulotomy.[1,2,3]

PCOs can occur in all age groups where an IOL implantation occurs.[4] Nd: YAG laser is a widely accepted, non-invasive, and convenient method of removal of PCOs. However, some complications are still associated with its use. Usually, the wavelength of 1064 nm is utilized for removal of PCOs yet, the energy can cause some disruption such as an increase in intraocular pressure, macular edema, decreased endothelial cell count of the cornea, retinal detachment, or iris inflammation. Generally, the laser is targeted on the PCO's but the cornea may be accidentally hit during the procedure causing stromal haze or loss of endothelial cells which controls the hydration state of the cornea.[5,6,7] A decrease in the cell count or disruption of the endothelium, causes corneal edema and vision deterioration. Specular microscopy can be used to assess and visualize the endothelial cell count and its structure.[4] Qasim *et al*, and Hasanain *et al*, highlighted that damage to the endothelium is more devastating than damage to other corneal layers. The normal density of cells in endothelium range from 4000-2400 cells per mm^2. The cell count decreases with age being the least in old age groups. It is known that Asians have slightly more cells in endothelium than other races of the same age group.

Posterior capsule opacification (PCO) is the most recurrent problem post phacoemulsification and lens implantation. In children, it is said to have an incidence of 100% between 2 months and 5 years after the cataract or lens surgery. The incidence is between 5% to 50% in adults.[4,8] Qasim *et al*. discovered a significant difference between the endothelial cell count pre-laser and post-laser (pre-laser=2356.76 cells/mm^{2}2, post-

Correspondence: Dr Amna Khan, Department of Ophthalmology, Armed Forces Institute of Ophthalmology Rawalpindi Pakistan

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laser 2199.2 cells/mm²2 at one-month follow-up). They concluded that the endothelial cell count decreases post-laser (p=0.00001). Similar results were proposed by Eleiwa *et al*.[8] and Kim *et al*.[9] that the endothelial cell count decreases post ND: YAG laser for PCO's treatment. Ruiz-Casas *et al*.[10] showed contrary results. They studied the complications of ND: YAG laser for treatment of PCOs and followed up with the patients after 3 months. They discovered that there was no association of ND: YAG laser and development of macular edema, endothelial cell loss, intraocular pressure increases, or any other complications.

Phacoemulsification is a frequent procedure and requires the use of IOL implantation which tends to develop PCOs, requiring ND; YAG laser capsulotomy. Hence the rationale of the study was to see the frequency of Implications and complications of the ND:YAG laser in the form of anterior segment chan-ges, to ensure proper laser protocols to avoid any vision hampering complications. The study aimed to assess the frequency of endothelial cell count loss after ND: YAG laser and the effect of different laser powers on corneal and anterior segment parameters.

METHODOLOGY

It was a quasi-experimental study conducted in Armed Forces Institute of Ophthalmology, Rawalpindi from July 2021 to Feb 2022. Written and informed consent was sought from the patients, after the approval from the hospital's ethical review committee (Ltr no. 236/ERC/AFIO dated 11 May 2020). The minimum required sample size was calculated to be 34 but we included 60 consecutive patients fulfilling the inclusion criteria in our study. The sample size calculation was based on 2.2% frequency of PCOs after cataract surgery, 90% study power, 95% level of confidence and 10% precision.[6] The sample collection was based on a non-probability convenience sampling technique.

Inclusion Criteria: All patients from ages 50-80 years age were included in the study with a history of PCOs with no complications & a lens in the posterior chamber. Patients with any duration of posterior capsular opacification causing visual disturbance for the patient were included and planned for ND: YAG capsulotomy.

Exclusion Criteria: Patients with corneal pathology, trauma, active or old uveitis, pseudoexfoliation, glaucoma and any pathology of retina were excluded. Patients with dislocated intraocular lens were also excluded.

Data Analaysis: Detailed history and ophthalmic examination were done for all patients before being enrolled for the study. All patients were instilled one percent tropicamide eye drops and 0.5% proparacaine hydrochloride eye drops to ensure pupil dilation and counter pain during procedure. Abraham's posterior capsulotomy lens was used to make 2-3 mm sized holes in the opacity. Zeiss VISULAS ND:YAG laser machine was used with energy of 1.2-2.5 MJ as per the need. The energy and number of shots were increased as per the thickness of the opacity. After the laser patients were prescribed prednisolone acetate (1.0%) drops and timolol maleate (0.5%) drops for use for two weeks. Data regarding pre-laser corneal endothelial cells count was collected from reports of specular micro-scopy (Topcon SP-3000P). Later the specular micro-scopy was repeated 4 weeks after the laser was done and parameters such as central corneal thickness, end-othelial cell count were noted. Intraocular pressure (IOP) was noted using Goldmann applanation tono-metery.

Data were analyzed by using SPSS ver 23 and paired samples T-test was used for comparing the means of variables in the results and p-value <0.05m was considered for comparison of results.

RESULTS

A total of 60 individuals with PCOs were enrolled in the study planned for Nd: YAG capsulotomy. Male patients 40(80%) with PCO's were found to be more in our sample than females 20(20%) (p=0.01). The mean age in the sample was 66.8±6.55 years (minimum=55 years, maximum=83 years). Two energy powers found to be used for the individuals were 1.2-2.0 MJ (n=34, individuals) and 2.1-2.5 MJ (n=26). It was found that after four weeks of YAG laser, there was no significant change in the intraocular pressure (p=0.334). However, the central corneal thickness with endothelial cell count reduced and the visual acuity improved Table-I.

The mean number of shots required to do posterior capsulotomy with 1.0 to 2.5MJ energy (18.46±2.10 shots) tended to be <2.1-2.5MJ energy (22.94±3.50 shots),

Table-I: Means of Ocular Parameters pre and Post- Nd: YAG Laser Capsulotomy

Parameters	Pre-Nd-YAG Laser Capsulotomy	Post-Nd-YAG Laser Capsulotomy	p-value
	Mean±SD (n=60)	Mean±SD (n=60)	
Intraocular pressure (mmHg)	15.02±2.94	14.87±2.70	0.334
Endothelial cell count (cells/mm²2)	2101±485	1919±427	<0.001
Central corneal thickness (mm)	0.504±0.03	0.502±0.03	0.010
Visual Acuity (LogMAR)	0.6±0.3	0.05±0.1	<0.001

Table-II: Means of Ocular Parameters Pre and Post- Nd: YAG Laser Capsulotomy using 1.0-2.1MJ Energy

Parameters	Pre-Nd-YAG Laser Capsulotomy	Post-Nd-YAG Laser Capsulotomy	*p*-value
	Mean±SD (n=34)	Mean±SD (n=34)	
Intraocular pressure (mmHg)	14.91±2.66	14.76±2.59	0.50
Endothelial cell count (cells/mm²2)	2132±574	1875±461	<0.001
Central corneal thickness (mm)	0.509±0.03	0.50±0.03	0.010
Visual Acuity (LogMAR)	0.75±0.3	0.09±0.10	<0.001

Table-III: Means of Ocular Parameters Pre and Post- Nd: YAG Laser Capsulotomy Using 2.1-2.5 MJ Energy

Parameters	Pre-Nd-YAG Laser Capsulotomy	Post-Nd-YAG Laser Capsulotomy	*p*-value
	Mean±SD (n=26)	Mean±SD (n=26)	
Intraocular pressure (mmHg)	15.5±3.33	15±2.89	0.516
Endothelial cell count (cells/mm²2)	2061±343	1976±379	0.07
Central corneal thickness (mm)	0.497±0.02	0.49±0.02	0.425
Visual Acuity (LogMAR)	0.50±0.24	0.02±0.04	<0.001

DISCUSSION

PCOs tend to occur after cataract surgery. Nd: YAG capsulotomy is the most common procedure used for it. It has almost negligible side effects however, multiple complications are reported due to the technique or energy power utilized in the varying process. A study was done by Pathak *et al*.[1] to assess the corneal structure changes and effects of YAG laser on the anterior chamber parameters. Around 50 individuals were followed up at one-week post laser and after four weeks, Specular microscopy was used to assess the structure of corneal layers and integrity of endothelial cells. It was found that visual acuity improved in the patients after laser. The endothelial cell count decreased from 2356.76 cells/mm²2-2199.2 cells/mm²2 after four weeks. A total of 157 cells/mm2 loss was detected (p=0.0001). In addition, structural changes were also observed. It was commented that the hexagonality changed after four weeks of the laser as well (p=0.0001). It was concluded that YAG capsulotomy is a safe procedure, however, the structural changes need to be catered for to avoid corneal integrity loss. These results were similar to our findings of loss of endothelial cell count post-YAG capsulotomy after four weeks.

Qasim *et al.* discovered that males (61%) were more affected than females (38%) in their sample which is similar to our findings.[4] They reported similar findings of a decrease in endothelial cell count after laser. Furthermore, they discovered a loss of 109 cells post-laser (p=0.04). Hence, they emphasized that even though YAG capsulotomy is a non-invasive procedure with very few complications, the corneal changes cannot be overlooked post-YAG capsulotomy.

Contrary results were observed by Kim *et al*.[9] in a prospective randomized study. It was observed that the best-corrected visual acuity (BCVA), endothelial cell count (ECC), intraocular pressure (IOP), and anterior segment elements did not show significant change post-YAG capsulotomy. Only the anterior chamber depth and angle showed a difference (p=0.034).

Contrary to our results, Ruiz-Casas *et al*.[10] found no significant change in the endothelial cell count, intraocular pressure, macular thickness, or corneal thickness post-YAG capsulotomy. However, improvement of vision was observed. These results were also supported in another study, where endothelial keratoplasty patients underwent YAG-laser-capsulotomy, and a decrease in endothelial cell count was noticed afterward.[11]

A prospective study by Agarwal *et al*. discovered that more energy used for the capsulotomy leads to more endothelial cell count loss. Similar to our findings of more mean cell count decrease with higher energy usage. It was reported by Agarwal *et al*. that the cell loss in the low energy count group was lower than in the higher energy group (175.68±72.42 cells/mm² (10.43%) & 214.88±97.68 cells/mm² (12.97%) respectively.[12]

In another study,[13] it was proposed that there is no change in the intraocular pressure, central corneal thickness, and after YAG-capsulotomy. However, visual improvement was noted which is contrary to our observation of significant change in the anterior segment paramters. Similar results were proposed by Shin *et al*.[14] Similar results of no change in central corneal thickness change were proposed by Akmaz *et al*.[15]

Our results showed that four weeks after the capsulotomy the mean intraocular pressures did not show adequate changes, which may be due to post-procedure usage of pressure lowering medication. As per literature a rise in intraocular pressure is observed after one hour of the procedure which settles by four weeks. Also that high power capsulotomies tend to show more variations in IOP than low power. It has

been documented that disturbance in the IOP is not of permanent nature.[16-18]

CONCLUSION

Our study revealed that the structural changes in cornea occur post-YAG capsulotomy, including changes in endothelial cell count. However, there is no significant disturbance observed in the intraocular pressures.

Conflict of Interest: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

AK: & AR: Supervision, Conception, Study design, analysis and Interperitation of data, Critically reviewed manuscript & approval for the final version to be published.

MHS: & SK: Co-supervision, Data entry, analysis and interpretation, manuscript writing & approval for the final version to be published.

TA: & NI Critically reviewed, Drafted manuscript & approval for the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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