

# The influence of size and shape of Nd: YAG capsulotomy on visual acuity and refraction

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## Abstract

Introduction of sharp-edge optic intraocular lenses (IOL) and the development of the modern phacoemulsification technique have resulted in reduced rates of posterior capsule opacification (PCO). Posterior capsule opacification is the most common complication of cataract surgery and results from the proliferation and migration of residual lenticular epithelial cells. PCO decreases visual acuity and contrast sensitivity leading to disability as a result of glare. Neodymium: yttrium-aluminum-garnet (Nd: YAG) laser capsulotomy has utility in the treatment of PCO. The purpose of this study was to evaluate the influence of size and shape of Neodymium: Yttrium Aluminum Garnet (Nd: YAG) laser capsulotomy on visual acuity and refraction. No significant change in SE following capsulotomy was observed in any group. BCVA significantly improved in all groups following capsulotomy. In conclusion, our study shows that Cruciate shape capsulotomy with an opening of 3.5 mm or less provides the greatest improvement in visual function following Nd: YAG capsulotomy in patients who have had uncomplicated cataract extraction surgery.

**Key Words:** Nd: YAG.

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## INTRODUCTION

Introduction of sharp-edge optic intraocular lenses (IOL) and the development of the modern phacoemulsification technique have resulted in reduced rates of posterior capsule opacification (PCO)<sup>1-3</sup>. Posterior capsule opacification is the most common complication of cataract surgery and results from the proliferation and migration of residual lenticular epithelial cells<sup>4-6</sup>. Opacification may be diminished by atraumatic surgery, complete cleaning of cortex residues, polishing of both anterior and posterior capsules, or the use of specific intraocular lens (IOL) designs<sup>7-10</sup>. The overall incidence of posterior capsule opacification (PCO) approaches 50% at 5 years following cataract surgery<sup>8-10</sup> and

disproportionately affects younger patients due to higher cell proliferation rates<sup>11</sup>. PCO decreases visual acuity and contrast sensitivity leading to disability as a result of glare<sup>12,13</sup>. Neodymium:yttrium-aluminum-garnet (Nd: YAG) laser capsulotomy has utility in the treatment of PCO; however, a number of complications of this procedure have been reported including IOL dislocation leading to hyperopia, IOL subluxation or luxation, IOP elevation, cystoid macular edema, and retinal detachment<sup>14-16</sup>. A number of Nd: YAG laser capsulotomy shapes and sizes may be utilized. Cruciate and circular shapes are most commonly performed with a wide range of opening sizes (3-6 mm). Specific capsulotomy shapes and sizes confer particular advantages and disadvantages<sup>17-18</sup>. Holladay *et al.*<sup>19</sup> concluded that the optimal capsulotomy should be equal or exceed the diameter of the pupil in the scotopic conditions and remain within the border of the IOL. Findl *et al.*<sup>20</sup> have shown that large capsulotomy size is associated with increased posterior movement of the IOL. Theoretically, large capsulotomy size may cause a hyperopic shift. However, a previous study reported a refractive change of 0.38 diopters in the patients with capsulotomy size smaller than 4 mm and 0.22 diopters in the patients with capsulotomy size equal or larger than 4 mm<sup>21</sup>. Elevated IOP is associated with an increased

amount of aqueous particles following Nd: YAG laser capsulotomy<sup>22,23</sup>. Ari *et al.*<sup>24</sup> underlined that the severity and duration of increased IOP is less when a total energy level less than 80 mj is used. In this study, we evaluated the effect of Nd: YAG capsulotomy size and shape on visual outcomes.

**Study Design**

Hospital based observational study with a quantitative components.

**Study Population**

With the conventional sampling method 20 PCO patients was examined to collect the data.

**MATERIALS AND METHOD**

**Inclusion Criteria**

Patients with PCO following cataract extraction with posterior chamber intraocular lens implantation complaining of dimision of vision

**Exclusion Criteria**

1. Patient with anterior segment abnormalities and posterior segment abnormalities such as with corneal opacities, glaucoma, retinopathy, maculopathy, and optic neuropathy and patients with diabetes mellitus.
2. Patients with IOL implantation other than posterior chamber IOL.
3. Patients with high myopic and hyperopic refractive errors greater than -6.0 or +6.0 diopters.

The study was adhered to the tenets of the Declaration of Helsinki, and The study was carried out in Acharya Vinoba Bhave Rural Hospital, and it was approved by an institutional ethical commitee of DMIMSU. Informed consent was obtained from all subjects after the nature and possible consequences of the study were explained to them. All patients were examined before and after Nd: YAG laser Capsulotomy. All patients were undergone a complete ocular examination on all visits, including best-corrected visual acuity (BCVA) in log MAR, subjective reffraction, slit-lamp, IOP measurement, and posterior segment examination. The IOP was recorded by NCT. The Optical Coherence Tomography (OCT) was done for macular thickness measurements. All patients were treated with Nd: YAG laser capsulotomy at a single center by a single surgeon. Tropicamide 1% and phenylephrine 2.5% was used for pupillary dilatation prior to procedure. After capsulotomy, E/D Timolol 5% BD for 15 days, E/D Flubiprofen TDS for 15 days, Tab Acetazolamide SR OD for 3 days were prescribed. Comparison of, best corrected visual acuity, refraction, IOP, before Nd: YAG laser capsulotomy and after Nd: YAG laser capsulotomy was done. All patients were divided into 4 groups, patients irrespective of their age

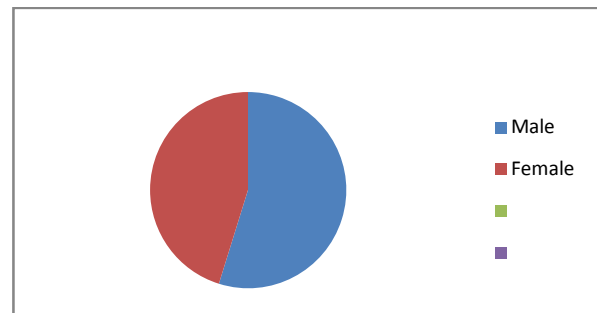
and sex and visual acuity and refractive status. Group 1- Cruciate shape capsulotomies with openings of less than or equal to 3.5mm. Group 2-Circular shape capsulotomies with openings of less than or equal to 3.5 mm. Group 3- Cruciate shape capsulotomies with openings of greater than 3.5 mm. Group 4-Circular shape capsulotomies with openings of greater than 3.5 mm.

**OBSERVATION AND RESULTS**

31 eyes of 31 patients were included in this study. 17 patients were male and 14 were female.

**Table 1:** Number of male and female patients involved in study

No Of Patients	
Male	17
Female	14



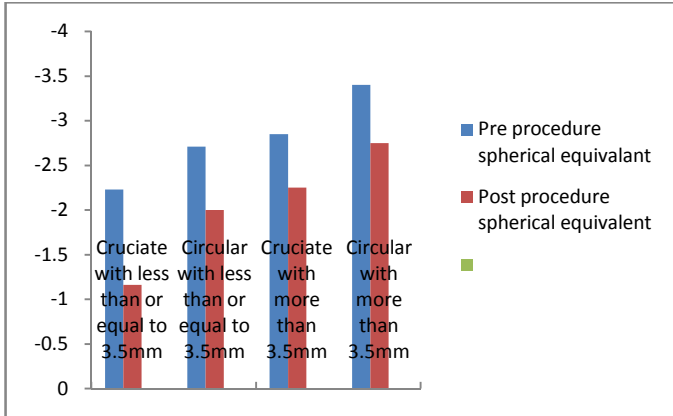
The interval between surgery and Nd: YAG laser Capsulotomy was approx 2-8 years. No significant difference in the interval between surgery and Nd: YAG laser Capsulotomy was observed between groups. It was observed that in younger patient there was early manifestation of PCO in comparison to elders.

**Spherical Equivalent**

The mean pre-procedural SE was -2.40 in Group 1, -2.89 diopter in Group 2, -2.17 diopter in Group 3, and -3.22 diopter in Group 4. The mean post-procedural SE was -1.75 diopter in Group 1, -2.28 diopter in Group 2, -1.75 diopter in Group 3, and -2.44 diopter in Group 4. No significant change in SE following capsulotomy was observed in any group.

**Table 2:** Comparison between pre procedural and post procedural spherical equivalent

	Pre procedure spherical equivalent	Post procedure spherical equivalent
Cruciate with less than or equal to 3.5mm	-2.40	-1.75
Circular with less than or equal to 3.5mm	-2.89	-2.28
Cruciate with more than 3.5mm	-2.17	-1.75
Circular with more than 3.5mm	-3.22	-2.44

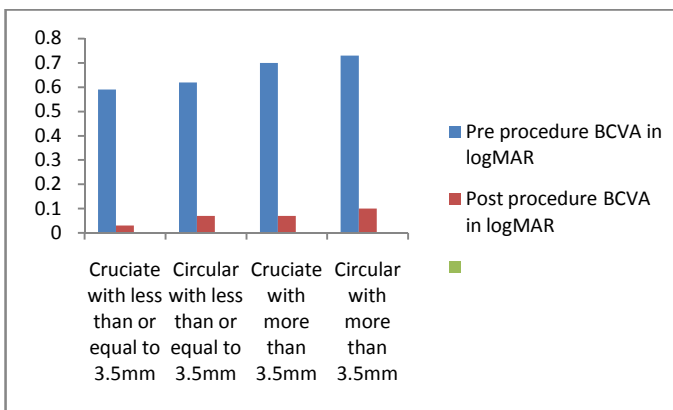


**BCVA**

The mean pre-procedural BCVA was 0.66 logMAR units in Group 1, 0.69 logMAR units in Group 2, 0.62 logMAR units in Group 3, and 0.66 logMAR units in Group 4. The mean post-procedural BCVA was 0.04 logMAR units in Group 1, 0.07 logMAR units in Group 2, 0.07 logMAR units in Group 3, and 0.08 logMAR units in Group 4. BCVA significantly improved in all groups following capsulotomy specially in group 1

**Table 3:** Comparison between pre procedural and post procedural bcva in logmar

	Pre procedure BCVA in logMAR	Post procedure BCVA logMAR
Cruciate with less than or equal to 3.5mm	0.66	0.04
Circular with less than or equal to 3.5mm	0.69	0.07
Cruciate with more than 3.5mm	0.62	0.07
Circular with more than 3.5mm	0.66	0.08



Initially slight raise in intraocular pressure was noticed which reduced on subsequent follow up.

**DISCUSSION**

Posterior capsule opacification is the most common delayed complication of cataract surgery. The incidence

of PCO was reported to be 20.7% at two years and 28.5% at 5 years after cataract surgery<sup>25</sup>. Although Nd: YAG laser capsulotomy has been found to be safe and effective, the procedure has potential to affect the position of the IOL. Findl *et al.*<sup>26</sup> reported that a subtle posterior shift of the posterior chamber IOL can occur but Thornval and Naeser<sup>27</sup> failed to observe this effect. In another study<sup>28</sup> the change in SE after Nd: YAG laser capsulotomy was statistically insignificant. Theoretically, posterior movement of the IOL may cause a hyperopic shift. In current study, we found a hyperopic shift in both small and large capsulotomy groups. The hyperopic shift was higher in large capsulotomy group 3 and 4 than in small capsulotomy group 1 and 2. As per our study we found in our study in smaller Capsulotomy provides improvement in visual acuity with minimum refractive changes as seen in smaller capsulotomy openings limit visual acuity by diffraction and result in light passing through the unopened region of the capsule being scattered causing glare and decreasing contrast sensitivity. Capsulotomy opening should therefore be equal to, or larger than, the size of pupil in scotopic conditions<sup>29</sup>. However, capsulotomy openings should be large enough to ensure good visualisation of the peripheral fundus. In larger Capsulotomy opening improvement in visual acuity was comparatively low with maximum refractive changes than in smaller Capsulotomy opening as seen in larger capsulotomy openings may increase risk of cystoid macular edema, vitreous prolapse, and retinal detachment[30]or cause posterior IOL dislocation leading to hyperopia<sup>31</sup>. In addition, a higher amount of energy is required that may increase the risk of retinal detachment<sup>32</sup>.

**CONCLUSION**

In conclusion, our study shows that Cruciate shape capsulotomy with an opening of 3.5 mm or less provides the greatest improvement in visual function following Nd: YAG capsulotomy in patients who have had uncomplicated cataract extraction surgery

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