

# Evaluation of quality of life and visual acuity after posterior capsulotomy with neodymium: YAG laser in adults

## *Avaliação da qualidade de vida e da acuidade visual após capsulotomia com Neodymium: YAG laser em adultos*

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### ABSTRACT

**Purpose:** To determine the impact of neodymium:YAG (Nd:YAG) laser posterior capsulotomy on quality of life and visual acuity in adults.

**Methods:** A prospective study that included patients over 65 years old with clinical indications for Nd:YAG laser capsulotomy. On the day of the procedure, corrected distance visual acuity tests, slit-lamp examination and posterior capsule opacification (PCO) photo documentation were performed, followed by application of the National Eye Institute Visual Function Questionnaire (NEI-VFQ-25). The PCO rate was evaluated with Evaluation of Posterior Capsule opacification (EPCO 2000) software. Four weeks after the posterior capsulotomy, corrected distance visual acuity was measured, and the NEI-VFQ-25 was applied again. Complications were also reported. **Results:** Sixty eyes from 45 patients were enrolled in the study. The mean age was  $71.51 \pm 6.38$  years (65 to 93). Comparing the results before and after the Nd:YAG laser capsulotomy, there was a statistically significant improvement in quality of life according to the NEI-VFQ-25 ( $p < 0.001$ ) and in visual acuity ( $p = 0.0$ ). The mean score in NEI-VFQ-25 Questionnaire before capsulotomy was  $62.07 \pm 20.90$  (16.81–95.90) and after was  $83.95 \pm 19.49$  (20.68 – 100.0). The mean CDVA before the procedure was  $0.75 \pm 0.35$  LogMAR (0.1–1.3) and after was  $0.21 \pm 0.20$  LogMAR (0.0–1.3). The mean PCO rate measured by the EPCO software was  $0.688 \pm 0.449$ . There was a positive correlation between the EPCO score and the total score of quality of life after Nd:YAG laser capsulotomy ( $r = 0.845$ ,  $p = 0.00$ ). Damage to intraocular lens was the only complication observed in six eyes (10%). **Conclusion:** Nd:YAG laser capsulotomy, in addition to improving visual acuity, is able to improve quality of life.

**Keywords:** Capsulotomy; Posterior capsule opacity; Quality of life, Cataract extraction; Vision disorders

### RESUMO

**Objetivo:** Determinar o impacto da capsulotomia posterior com laser de neodímio: YAG (Nd:YAG) na qualidade de vida e na acuidade visual em adultos. **Métodos:** Estudo prospectivo que incluiu pacientes acima de 65 anos com indicação clínica para capsulotomia com laser de Nd:YAG. No dia do procedimento, foram realizados testes de acuidade visual corrigida, exame com lâmpada de fenda e fotodocumentação da opacificação da cápsula posterior (OCP), seguido da aplicação do National Eye Institute Visual Function Questionnaire (NEI-VFQ-25). A taxa de OCP foi avaliada utilizando o software de avaliação de opacificação de cápsula posterior (EPCO 2000). Quatro semanas após a capsulotomia posterior, a acuidade visual corrigida foi medida, e o NEI-VFQ-25 foi aplicado novamente. Complicações também foram relatadas. **Resultados:** Sessenta olhos de 45 pacientes foram incluídos no estudo. A idade média foi de  $71,51 \pm 6,38$  anos (65 to 93). Comparando os resultados antes e após a capsulotomia com laser Nd:YAG, houve melhora estatisticamente significativa na qualidade de vida de acordo com o NEI-VFQ-25 ( $p < 0,001$ ) e na acuidade visual ( $p = 0,0$ ). A média do escore total do questionário NEI-VFQ-25 pré capsulotomia foi de  $62,07 \pm 20,90$  (16,81-95,90) e pós foi de  $83,95 \pm 19,49$  (20,68 – 100,0). A AVCC antes do procedimento foi  $0,75 \pm 0,35$  LogMAR (0,1-1,3) e após foi  $0,21 \pm 0,20$  LogMAR (0,0-1,3). A taxa média de OCP medida pelo software EPCO foi de  $0,688 \pm 0,449$ . Houve correlação positiva entre o escore EPCO e o escore total de qualidade de vida após a capsulotomia com laser de Nd:YAG ( $r = 0,845$ ,  $p = 0,00$ ). O dano à lente intraocular foi a única complicação observada em seis olhos (10%). **Conclusão:** A capsulotomia com laser Nd:YAG, além de melhorar a acuidade visual, é capaz de melhorar a qualidade de vida.

**Descritores:** Capsulotomia; Opacidade de cápsula posterior; Qualidade de vida; Extração de catarata; Distúrbios da visão

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## INTRODUCTION

Despite advances in cataract surgery techniques and intraocular lens (IOL) designs, posterior capsule opacification (PCO) is still a common, long-term complication, leading to a progressive decrease in visual acuity (VA), contrast sensibility and quality of life.<sup>(1-4)</sup> PCO is a result of the proliferation and migration of the remaining lens epithelial cells (LECs) towards the posterior capsule after cataract surgery,<sup>(1)</sup> and most of them are successfully treated with Nd: YAG laser capsulotomy.<sup>(2,3)</sup> Surgical techniques, age of the patient, IOL features, patient comorbidity and follow-up period are the main factors related to the development of PCO.<sup>(1,4)</sup> The visual function assessed by questionnaires allows us to quantify the impact of ocular diseases and their treatment on a patient's life in terms of social, physical and mental aspects. The National Eye Institute-Visual Function Questionnaire (NEI-VFQ-25) is able to evaluate vision specifically in terms of quality of life and has been successfully used in ophthalmology to assess the effects of cataract surgery,<sup>(4)</sup> retinal detachment,<sup>(5)</sup> glaucoma,<sup>(6)</sup> uveitis,<sup>(7)</sup> keratoconus,<sup>(8,9)</sup> vitreoretinal disorders;<sup>(10)</sup> however, it was never used to assess the impact of PCO on quality of life.

Since the transparency of the visual axis is fundamental to maintaining a satisfactory VA after cataract surgery and because of increasing life expectancies, it is crucial to quantify the effect of the severity of the PCO in quality of life and in visual function. Therefore, this prospective study aims to correlate the VA and PCO rate measured by EPCO 2000 software with the improvement in quality of life by the NEI-VFQ-25 before and after Nd: YAG laser capsulotomy and report the complications related to this procedure.

## METHODS

This prospective blind study included patients over 65 years of age who underwent posterior capsulotomy with a Nd: YAG laser at the Humberto Castro Lima Hospital, Salvador, Brazil, between November 2016 and April 2017. The study was conducted in accordance with the tenets of the Declaration of Helsinki and was approved by the Ethics Committee of the Clinical Board of the Fund Economic, Scientific, Technological and Innovation Development (FUNDECI) and number CAAE: 57523316.3.0000.5544. Informed consent was also obtained from all patients. Patients with neurological delay were excluded.

### Data collection

A complete ophthalmologic examination was performed on all patients twice, on the day of the procedure and four weeks later. It included corrected distance visual acuity (CDVA) using a Snellen chart, Goldmann applanation tonometry, funduscopy and slit-lamp evaluation. Moreover, the NEI-VFQ-25, validated in Portuguese in 2008, was applied.<sup>(11)</sup> This questionnaire is a complete method to evaluate visual function and quality of life, assessing various aspects of a patient's daily activities. It consists of 25 items grouped into 12 subscales that measure vision-targeted health-related quality of life (HRQOL), assessing general health, general vision, ocular pain, near activities, distance activities, social functioning, mental health, role difficulties, dependency, driving, color vision, and peripheral vision.<sup>(12,13)</sup> The score is given by the sum of each item ranging from 0 to 100. Higher scores reflect better vision-related quality of life. The global score is the mean score of

all items that constitute 11 of the 12 subscales, with the exception of the single item that constitutes the general-health subscale.<sup>(14)</sup>

### Nd: YAG laser capsulotomy and PCO documentation

Maximum mydriasis was obtained with tropicamide 1% (Mydracyl<sup>®</sup>) and phenylephrine (Fenilefrin<sup>®</sup>) eye drops. Brimonidine tartrate 0.2% (Glaub<sup>®</sup>) was applied 1 hour before and immediately after the procedure. Dexamethasone 0.1% (Maxidex<sup>®</sup>) was also administered after the procedure. On slit-lamp examination, clinical PCO evaluation was performed, and IOL placement was evaluated. Clinical classification of PCO was based on density and type.<sup>(15)</sup> Digital retroillumination images of the posterior capsule at the slit-lamp were made (with a Canon EOS 5D camera attached to a Huvitz slit lamp with a Canon SLR/D-SLR adapter). The photos were imported to the Evaluation of Posterior Capsule opacification software (EPCO 2000) to quantify the PCO, which uses the density of the PCO (graded from 1 to 4) and the area involved to calculate the PCO score. Graduation provided by the program was compared with clinical results obtained by slit lamp examination. For the other results, only the EPCO score from the software was used. The Nd: YAG laser (3000-LE, Alcon Laboratories Inc., Fort Worth, TX, USA) was performed by a single experienced ophthalmologist with a central pattern of 4 mm under topical anesthesia with drops of 0.5% proparacaine hydrochloride (Anestalcon<sup>®</sup>). The initial energy used was 0.8 mJ and was progressively increased as required up.

Intraocular pressure was measured one hour following the procedure. Dexamethasone 0.1% (Maxidex<sup>®</sup>) eye drops were given three times daily for five days. After four weeks, CDVA, slit-lamp examination and intraocular pressure were reported. The NEI-VFQ-25 was applied for the second time by the same initial masked evaluators. Two months after the procedure, a complete ophthalmological examination was performed to evaluate complications.

### Statistical analysis

All quantitative data were expressed as the mean and standard deviation. Qualitative variables were expressed as absolute and relative frequencies. A p-value <0.05 was considered statistically significant. The unpaired t-test was used to compare the results of the questionnaire before and after the procedure. Spearman correlation was used to evaluate relationships of variables before and after the procedure. The Statistical Package for the Social Sciences (SPSS, Inc. version 19.0) for Windows software was used for statistical analysis.

## RESULTS

A total of 45 patients (60 eyes) were included. Table 1 shows the demographics and ocular characteristics of the patients. There was a significant improvement in VA (p=0.00) with the Nd: YAG laser capsulotomy. Among three patients whose VA did not improve (5%), all of them had previous eye clinical conditions prior to posterior capsulotomy (two had advanced glaucoma and one featured prior retinal detachment). Damage to IOLs (pits) was the only complication, observed in six eyes (10%).

The mean EPCO score was  $0.688 \pm 0.449$  (range 0.234 to 1.986), and the mean manual PCO score was  $2.55 \pm 0.76$ . There was a significant positive correlation between the EPCO score and the manual PCO score,  $r = 0.59$  (p=0.00) and a negative correlation between the EPCO score and CDVA after Nd: YAG

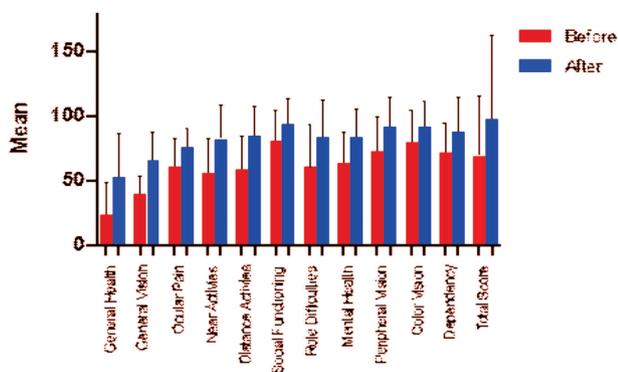
laser capsulotomy using LogMAR,  $r = -0.194$  ( $p = 0.13$ ). The EPCO score analysis with the difference (delta,  $\Delta$ ) between the CVDA before and after Nd:YAG laser capsulotomy shows  $r = -0.173$  ( $p = 0.255$ ). Moreover, there was a significant positive correlation between the EPCO score and the total score of quality of life measured by the NEI-VFQ-25 after Nd:YAG laser capsulotomy,  $r = 0.845$  ( $p < 0.001$ ). The EPCO score analysis with the difference (delta,  $\Delta$ ) between the total score of quality of life measured by the NEI-VFQ-25 after Nd:YAG laser capsulotomy shows  $r = 0.108$  ( $p = 0.482$ ).

Figure 1 shows the results of the NEI-VFQ-25 before and after the procedure, reporting an improvement of life after the posterior capsulotomy. Among the 12 subscales of the NEI-VFQ-25, the four with the highest average scores after the procedure were total score (97.28), social functioning (93.88), color vision (91.66) and peripheral vision (91.11). The four subscales with the lowest averages were general health (52.22), general vision (65.77), ocular pain (75.38) and near activities (81.94). Of the included patients, only two usually drive.

**Table 1**  
Sociodemographic and clinical ocular characteristics of patients

Age (y) m $\pm$ SD (range)	71.51 $\pm$ 6.38 (65 to 93)
Female n (%)	29 (48.3)
Unilateral n (%)	31 (51.7)
Time after cataract surgery (y) M (IR)	2 (2-5)
Mean IOP (mmHg)	11.52 $\pm$ 2.42 (8-22)
Energy used in Nd:YAG laser m $\pm$ SD (range)	2.44 $\pm$ 0.53 (1.8-3.8)
CDVA before the procedure (LogMAR)	0.75 $\pm$ 0.35 (0.1-1.3)
CDVA after the procedure (LogMAR)	0.21 $\pm$ 0.20 (0.0-1.3)

Y=years; m=mean; M=median; IR= interquartile range; SD= standard deviation; CDVA: corrected distance visual acuity



**Figure 1:** Comparison of the mean National Eye Institute Visual Function Questionnaire-25 scores before and after the Nd:YAG laser posterior capsulotomy.

## DISCUSSION

The improvement in VA after posterior capsulotomy is well documented; however, the effect of the severity of PCO on visual

function and quality of life has not yet been documented. This study reported the correlation between PCO density measured by EPCO software and quality of life measured using the NEI-VFQ-25 after PCO treatment with Nd:YAG laser capsulotomy. The NEI-VFQ-25 met our needs and showed that quality of life can be improved after PCO treatment in adults. Additionally, our results demonstrate that NEI-VFQ-25 is a useful tool to use before the Nd:YAG laser capsulotomy to evaluate visual function.

The EPCO system is one of the most commonly used software to evaluate PCO scores.<sup>(16)</sup> We reported similar results in clinical PCO evaluation and EPCO score, demonstrating that both were efficient to documented PCO rate. Barman et al.<sup>(17)</sup> used POCO software to measure the PCO rate and reported a significant correlation between VA and the severity of the PCO. In addition, using an axial densitometry of the Scheimpflug videophotography system to measure the central posterior capsule, Hayashi et al.<sup>(18)</sup> demonstrated a strong correlation between VA and the PCO value before capsulotomy ( $r = 0.72$ ) and a significant correlation ( $r = 0.42$ ) between improvement in VA and decrease in the PCO value after capsulotomy. Cheng et al.<sup>(19)</sup> evaluated PCO by clinical examination on a slit lamp and compared two groups with different types of PCO formation (fibrosis vs. pearl), showing VA improvement in both groups after capsulotomy. These results support the idea that dense PCO, which requires Nd:YAG laser capsulotomy, will evolve with VA improvement after the procedure. Our patients had a statistically significant improvement in VA after posterior capsulotomy.

Most of the studies in the literature described PCO and its correlation with visual function, but only a few mentioned the relationship between PCO and quality of life. de Juan-Marcos et al.<sup>(20)</sup> demonstrated a significant improvement in patient quality of life after capsulotomy using two questionnaires, a disease-specific visual function (VF-14 Index) and a generic one, the EuroQoL instrument (EQ-5D). The VF-14 showed a moderate correlation ( $r = 0.36$ ) in VA improvement (90.6%) and a strong correlation ( $r = 0.72$ ) in satisfaction with vision after the capsulotomy. These data suggest that specific functional status measures, such as the VF-14, are more sensitive to functional disability evaluations caused by PCO and VA improvements after posterior capsulotomy than a general health status instrument, such as EuroQoL. We used the NEI-VFQ-25 to assess quality of life in this study. This instrument is widely used in ophthalmology, but we used it for the first time to assess VA impact on quality of life after posterior capsulotomy.<sup>(12,21)</sup> Both the VF-14 and the NEI-VFQ-25 measure visual function based on daily activities, and they are reliable and validated for evaluating impairment caused by cataracts,<sup>(22)</sup> but the VF-14 did not consider visual field defects or color vision.<sup>(21)</sup> The NEI-VFQ-25 has more clinical emphasis, is reliable and easy to use and takes roughly five minutes to be applied. Among the questionnaires to assess quality of life, the NEI-VFQ-25 was the one that completely met our purposes for this research. The SF-36 (Study short form – 36) is a multipurpose health survey but has a weak correlation with visual function.<sup>(21)</sup> The SIP (Sickness Impact Profile) is validated and reliable but is not easy to use, too long and unpractical for use in the clinical setting.<sup>(21)</sup> Although the Activities of Daily Vision Scale (ADVS) is reliable, easy to use and a good instrument to assess VA and visual field, it does not evaluate peripheral vision.<sup>(21)</sup> The NEI-VFQ-25 has the same benefits, evaluates peripheral vision and is validated in Brazilian Portuguese.<sup>(11)</sup>

Nd:YAG laser capsulotomy is considered a simple and safe procedure,<sup>(23)</sup> but there are some complications (e.g., elevated intraocular pressure, iritis, corneal damage, IOL damage, movement

or dislocation, cystoid macular edema, disruption of the anterior hyaloid surface, and increased risk of retinal detachment).<sup>(24,25)</sup> There were no complications that significantly decreased VA in this study; only optic pitting was reported in 10% of patients, which is in accordance with the literature (4 and 40% of the cases).<sup>(26)</sup> Even with lens damage, these patients have an improvement in VA and in quality of life. Most studies have shown that little optic pitting does not cause a significant effect on clinical visual function.<sup>(27)</sup> No correlation between laser energy and pitting was found in our study; however, Bhargava et al.<sup>(28)</sup> showed a significant association between energy levels and complications. They used an initial energy for membranous, fibrous and fibro-membranous PCO of 1.8, 2.8 and 2.5 mJ, respectively. In our study, the initially energy used was 0.8 mJ,<sup>(29)</sup> however, energy below 1.8 mJ was not efficient in opening the capsule of the patients studied. Our results support that Nd:YAG laser capsulotomy is efficient, but we recommend using lower energy as necessary to avoid additional complications.

This study was limited because not all medical records were obtained since some patients had their cataract surgery performed in other hospitals. It is important to stress that this was the first study to quantify PCO rates and correlate them with quality of life using the NEI-VFQ-25 and VA, which prevented comparison of the results with an equivalent study. The improvement in quality of life was evidenced. In conclusion, the Nd:YAG laser capsulotomy is an efficient treatment for PCO, and the NEI-VFQ-25 is adequate to study the quality of life after posterior capsulotomy.

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