



THE EFFECT OF ND YAG LASER POSTERIOR CAPSULOTOMY SIZE ON REFRACTION AND INTRAOOCULAR PRESSURE IN PSEUDO PHAKIC PATIENTS

¹*Dana Jamal Roqieh, ²Mahmoud Rajab and ³Afraa Salman

¹Department of Ophthalmology, Tishreen University Hospital, Lattakia, Syria.

^{2,3}Department of Ophthalmology, Professor, Tishreen University Hospital, Lattakia, Syria.



***Corresponding Author: Dana Jamal Roqieh**

Department of Ophthalmology, Tishreen University Hospital, Lattakia, Syria.

Article Received on 24/05/2024

Article Revised on 14/06/2024

Article Accepted on 05/07/2024

ABSTRACT

Objective: To study the effect of Nd YAG Laser Posterior Capsulotomy Size on refraction error-intraocular pressure and anterior chamber depth in patients with pseudophakia. **Study Type:** prospective comparative study.

Methods: The study sample included 50 patients (50eyes) with posterior capsule opacification following phacoemulsification cataract surgery, the average age was 58.75 ± 10.9 (range 45-75 years). Detailed medical history was taken and all patients underwent detailed ophthalmic examination including the measurement of refraction errors. BCVA, spherical equivalent calculation, intraocular pressure measurement and anterior chamber depth was assessed by ultrasound bio microscopy before and after Nd YAG laser Posterior capsulotomy procedure at 1 week, 1 month, and 3 months. The subjects were divided into two groups based on the size of PCO capsulotomy: Group1(3-4)mm and Group2(4.1-5)mm. **Results:** our study showed improvement in corrected distance visual acuity in both large and small PCO capsulotomy groups with no statistically significant differences between the two groups. Hyperopic shift was observed in both groups with higher shift noted in the large PCO capsulotomy group. Intraocular pressure increased significance in both groups during the first week post -procedure but remained within normal upper limits accompanied by changes in anterior chamber depth with greater increase observed in group2. No macular edema or retinal detachment occurred in both groups during the follow-up period. **Conclusion:** Nd YAG laser posterior capsulotomy in patients with pseudophakia improves corrected distance visual acuity and induces hyperopic shift particularly in larger capsulotomy group with intraocular pressure elevation with normal limits during the first week post procedure and increased anterior chamber depth especially in the larger capsulotomy group.

INTRODUCTION

The thickening of the healthy posterior capsule after cataract surgery(posterior capsular opacification [PCO]) is the most common complication of cataract surgery by extracapsular extraction method (ECCE), and by ultrasonic emulsification method (phaco).^[1]

The Opacification of the posterior capsular arises from the continuous vitality of the epithelial lens cells that remain after the removal of the nucleus and the peel, and these cells reproduce according to several models, including elsheng pearls that resemble fish eggs are placed on the posterior capsular. Epithelial cells migrate through the anterior and posterior capsular and lead to capsular wrinkling and opacification, as the cells of the epithelial lens are amenable to metaplasia and transformation into myofibromatosis, when the collagen parenchyma contracts, this leads to wrinkling of the posterior capsular, and therefore blurred vision and the occurrence of dazzle.^[1]

The incidence of optically significant posterior capsular opacification is about 28% after 5 years, as the quantitatively measured opacification within three years after surgery varies depending on the type of lens material, and it is currently believed that this difference is due to different lens design or overlay of the anterior capsular than the lens material.^[2-5]

Nd YAG laser YAG is considered the standard procedure for the treatment of secondary opacification in the posterior capsular, anterior capsular stenosis following cataract surgery with the possibility of using a cutting scalpel through an external corneal incision to open the condensed capsular in special cases.^[6]

The YAG laser procedure has many effects, as the increase in intraocular pressure after posterior capsulotomy with YAG laser is a major complication encountered. The reason for this increase is uncertain, but it is indicated that it may be caused by the liberation of the cells of the lens epithelium within the anterior chamber or the liquefaction of the vitreous and its

movement forward, as some authors argue and insist that the increase in intraocular pressure after laser posterior capsulotomy is associated with large capsulotomy and increased energy.^[7-11] Several studies have also found changes in refraction worsens after YAG laser posterior capsulotomy.

Considering that YAG laser posterior capsulotomy is a gold standard in the treatment of posterior capsular opacification after cataract operations, which is a common and important reason for preventing access to the best visual acuity after surgery, it was necessary to study the effect of the size of the posterior capsulotomy on the refractive state, intraocular pressure, and assessing the depth of the anterior chamber to obtain and maintain the best possible visual acuity.

OBJECTIVES

- Main objective:** To study the effect of Nd YAG Laser Posterior Capsulotomy Size on refraction error-intraocular pressure.
- Secondary objective:** Study the effect of Nd YAG laser on The anterior chamber depth.

MATERIALS AND METHODS

Study design: A prospective comparative study.

Study Place and duration

This study was conducted at ophthalmology department in Tishreen university hospital, Lattakia, Syria from February 2023 to march 2024.

Study Sample

This study has included A total of fifty pseudo phakic eyes of fifty patients with PCO following uncomplicated phacoemulsification. Patients aged 45-75 with a mean age of (58.75±10.9).

METHODOLOGY

All patients underwent an ophthalmic evaluation pre and postNd: YAG laser capsulotomy. Post procedure follow-up was divided into 3 visits (1st week, 1st month, and 3rd month).The examination included, best-corrected visual acuity (BCVA), Autorefraction, spherical equivalent" RE" values, examination on slit-lamp, IOP measurement using goldman tonometer, examination of ocular fundus after pupil dilation using tropicamide 1%, and anterior chamber depth(ACD) measurement by ultrasound biomicroscope. In our study we excluded, patients who have passed less than three months after phacoemulsification cataract surgery, any complication during and after surgery, uncooperative patients, any ocular diseases that affect visual acuity, corneal opacities, glaucoma, IOP measurement more than 21 mm. hg, narrow pupils less than 3mm which is not expandable. We depended on using Tropicamide 1% for pupillary dilatation prior to procedure. After capsulotomy, dexamethasone 0.1% four times daily was applied for a week, we didn't use any antiglaucoma medication.

Patients were divided into two groups based on the posterior capsulotomy size. The size of the posterior capsule opening was measured vertically and horizontally using the reticule of the slit-lamp and the average of these values was accepted, twenty-eight patients with capsulotomy size smaller than 4mm were considered as group 1(3-4), Twenty-two patients with capsulotomy size larger than 4mm were considered as group 2(4.1-5). The total energy used in capsulotomy was 66.95 ± 8.2 mJ (range:44 - 75) in group 1, and 65.22 ± 10.2 mJ (range 38 – 85) in group 2 There was no significant difference between two groups depending on total energy($P=0.9$). Two groups were compared based on changes in BCVA, SE, IOP, and ACD. any cystoid macular edema, retinal tear, or detachment was observed by biomicroscope post procedure during the follow-up period.

Statistical analysis

IBM SPSS statistics (version20) was used for statistical analysis.

The independent-t-test was used for comparison of two groups, Pearson Correlation used to study the correlation of quantitative variables. Comparison of Qualitative variables between groups was carried out with chi-square test.

RESULTS

In our study the age ranged between 47 & 73 years in group 1 with a Mean of 59.62 ± 10.2 years, in group 2 the age ranged between 45 & 75 years with a mean of 57.88 ± 11.6 years without a significant difference (p value =0,2).

In group 1, 15patients were male and 13patients were female; in group 2, 13patients were male and 9 patients were female, without a statistically significant difference between two groups(P value =0,5).

Mean capsulotomy size was 3.68 ± 0.1 mm (range:3-4) in group 1 and 4.57 ± 0.3 mm (range: 4.1–5) in group2. Mean capsulotomy size was significantly larger in group 2(P value= 0.02). [table 1]

Table 1: capsulotomy size in two groups.

Capsulotomy Size	Group 1	Group 2	P-value
Mean ± SD (mm)	3.68 ± 0.1	4.57 ± 0.3	
Min – Max(mm)	3-4	4.1 – 5	0.02

Best-corrected visual acuity (BCVA) at 1st week, 1stmonth, and 3rd month was improved statistically significant in both small and large capsulotomy groups ($P=0.0001$) with better improvement in group2 without statistically significant difference compared with group 1.[figure 1]

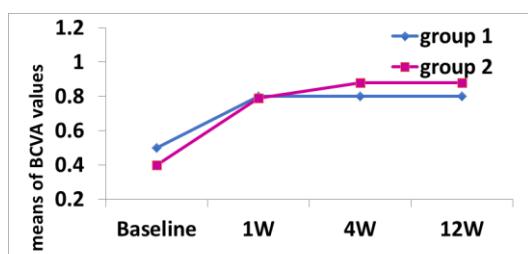


Figure 1: comparison between groups according to Best-corrected visual acuity.

Spherical Equivalent (SE) decreased in the subsequent follow-up period in both groups with a statistically significant difference (P value = 0.0001). The biggest decline was in group 2 with statistically significant difference in all follow-up period, This mean occurrence hyperopic shift in both groups with higher shift in large group.

Table2: comparison between group according to SE.

Time	Group 1	Group 2	P value
Pretreatment	- 1.21±1.3	- 1.30±1.2	0.3
1 st week	- 0.90±1.04	- 1.30±1.2	0.03
1st month	- 0.93±1.09	- 0.82±1.02	0.02
3rd month	- 0.92±1.02	- 0.78±1.5	0.04
P- value	0.0001	0.0001	

In both groups, Transient increase in intraocular pressure (IOP) was observed at 1st week after Nd:YAG laser capsulotomy (P = 0.002.) in both groups with greater high in group 2. Intraocular pressure declined to

preoperative levels at 4 weeks after Nd:YAG laser capsulotomy in both groups. And no patient in both groups suffered from serious rise of IOP. [figure 2]

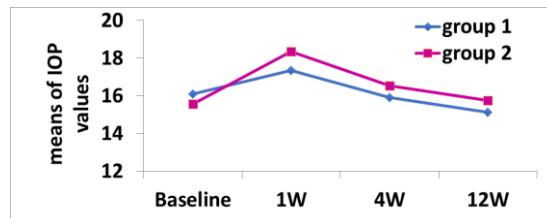


Figure 2: Comparison Between Groups According To Intraocular Pressure.

There was statistically significant increase in anterior chamber depth in both groups ($P=0.03$, $P= 0.001$, resp.) with greater increase in group 2 than group 1 during follow-up period at 1 month, 3 months with statistically significant difference ($P= 0.02$, $P=0.04$, resp.).

We didn't observe any case of Cystoids macular edema, or retinal tear during follow-up period. [Table 3]

Table 3: Comparison Between Groups According to Anterior Chamber Depth.

Time	Group 1	Group 2	P-value
Pretreatment	3.93±0.27	3.92±0.36	0.2
1 st week	3.94±0.24	3.97±0.33	0.05
1 st month	3.94±0.29	3.98±0.35	0.02
3 rd month	3.95±0.28	3.99±0.34	0.04
P- value	0.03	0.001	

Table 4: Comparison of mean capsulotomy size, BCVA, SE, IOP, and ACD between groups before Nd:YAG laser capsulectomy and 1week, 1month, and 3months after Nd:YAG laser capsulotomy

		Group1	Group2	P value
Capsulotomy size		3.68±0.1	4.57±0.3	0.02
*BCVA	Pretreatment	0.50±0.22	0.40±0.18	0.2
	1week	0.80±0.13	0.79±0.15	0.7
	1month	0.80±0.11	0.88±0.13	0.06
	3months	0.81±0.20	0.88±0.14	0.9
SE (diopters)	pretreatment	- 1. 21±1.3	- 1.30±1.2	0.3
	1week	- 0.90±1.04	- 0.82±1.0	0.03
	1month	- 0.90±1.04	- 0.82±1.02	0.03
	3months	- 0.92±1.02	- 0.77±1.4	0.04
IOP (mmHg)	pretreatment	16.12±2.5	15.58±2.8	0.2
	1week	17.35±2.7	18.34±3.2	0.002
	1month	16.35±2.9	16.55±3.9	0.08
	3months	15.92±2.6	15.77±3.1	0.09
ACD(mm)	pretreatment	3.93±0.27	3.92±0.36	0.2
	1week	3.94±0.24	3.97±0.33	0.05
	1month	3.94±0.29	3.98±0.35	0.02
	3months	3.95±0.28	3.99±0.34	0.04

*BCVA: best-corrected visual acuity ; SE: spherical equivalent (diopters); IOP: intraocular pressure; (mm.hg); ACD:anterior chamber depth(mm).

DISCUSSION

- The Nd : YAG laser posterior capsulotomy considered the golden standard procedure of the PCO because it can be safe and effective, and can improve the visual acuity of patients with PCO.^[6] However, it has several complications, such as transient elevation in the IOP, and affect the position of the IOL.
- There was a statistically significant difference and stable improvement in the BCVA after the laser capsulotomy in both groups during follow-up period, in agreement with the current results, Hayashi et al.^[15] and Karahan et al.^[13], Mohamed R.A. Amra et al^[16], Chao-Yu Hu et al^[14] reported that there is a statistically significant improvement in the BCVA after the Nd : YAG laser posterior capsulotomy in both groups. This improvement of BCVA can be caused by removing the posterior capsule opacification on optical axis. In addition, the contrast sensitivity and the glare after the capsulotomy are better than pre procedure especially in group2.
- In current study, there were statistically significant changes in the spherical equivalent after the capsulotomy in both groups. We found a hyperopic shift in both small and large capsulotomy groups. higher shift was found in large group than in small capsulotomy group, The hyperopic shift was progressive in all follow-up visits, this hyperopic shift might be caused by the subtle posterior shift of the posterior chamber IOL which was supported by the results of ACD measurement. This result agreed with the study of Karahan et al.^[13]
- Our study was in difference with Chao-Yu Hu et al^[14] they didn't observe any significant changes in SE values, but they observed significant decreases in the magnitudes of refractive astigmatism and residual astigmatism.
- The mean IOP levels were significantly higher than preoperative levels in both groups after 1 week post procedure, we found that the increase in IOP was higher in group2 than that in group 1 with statistically significant differences ($P=0.002$), without clinical importance, The mean IOP reduced to the baseline level within 1st month and 3rd month visits after the procedure in both groups, The main cause of this increase was the releasing of capsule particles which can be more in large capsulotomy in comparison with small capsulotomy group. in addition, the elevation of IOP at the 1st week post procedure might be caused by using dexamethasone drop during the first week. Our study was in agreement with Karahan et al.^[13], who observed that the mean IOP levels were significantly higher than preoperative levels in both groups. With higher increase in large capsulotomy group, also we were in agreement with Mohamed R.A. Amra et al^[16] they also observed a statistically significant increase of the mean IOP at the second visit in the two groups ($P<0.001$), we were in contrast with Chao-Yu Hu t

al^[14], hence they didn't observe any statistically significant differences in, IOP.

- In our study ACD measurements increased with statistically significant differences in both groups with statistically significant higher increase in group2 at 1st month, 3rd month visits post procedure. This increase might be caused by the subtle posterior shift of the posterior chamber IOL, This increase of ACD values was in agreement with Anil Parajuliet al^[17], who observed a continuous increase in ACD measurements with significant difference in both groups at both 1st hr and 1st month followup visits, we were in contrast with Chao-Yu Hu et al^[14], they didn't observe statistically significant differences in ACD, this might be because of using noncontact device, the EAS-1000, to obtain Chemiflux slit images, incomparison with our study we used ultrasound biomicroscope (echo A) contact device.in addition Chao-Yu Hu et al.^[14] their study consisted extra capsular extraction with implant hard lenses in the sulcus which have heigh stability so the possibility of lens movement is difficult.

CONCLUSION

- Nd YAG laser posterior capsulotomy in patients with pseudophakia improves corrected distance visual acuity and induces hyperopic shift particularly in larger capsulotomy group with intraocular pressure elevation with normal limits during the first week post procedure and increased anterior chamber depth especially in the larger capsulotomy group.
- We recommend to do more studies with comparing the relation between the total energy used in the procedure and intraocular pressure elevation, and comparing between the effect of corticosteroids, or nonsteroidal anti-inflammatory drugs on intraocular pressure post procedure.

ACKNOWLEDGMENTS

We wish to thank all medical staff in Otorhinolaryngology Department at Tishreen University Hospital for their hard work.

Financial Support

None.

Conflict of Interest

The authors declare that they have no conflict of interest.

REFERENCES

1. Apple DJ Solomon KD Tetz MR et al posterior capsule opacification. *Surv Ophthalmol*, 1992; 37-116.
2. Hollick EJ Saplon DJ Ursell PG et al. The effect of polymethyl-methacrylate silicone and polycrylic intraocular lenses on posterior capsular opacification 3years after cataract surgery *Ophthalmology*, 1999; 106: 49-55.

3. Nishi OPosterior capsule opacification. Part1: Experimntal investigation. *J Cataract Refract Surg*, 1999; 25: 106 117.
4. Oslen GM Olson RJ. Prospective study of cataract surgery, capsulotomy and retinal detachment *JCataract Refract Surg*, 1995; 21: 136-139.
5. Schaumberg DA Dana MR Christen WG et al. A systematicv overview of the incidence of posterior capsule opacification *Ophthahmology*, 1998; 10.
6. Kolder HE. WeingeistTA, Sneed SR, eds. YAG laser capsulotomy. In *laser Surgery in Ophthalmology :Practical Application*. Norwalk, CT: Appleton & LALange, 1992; 167-174.
7. Steinert RF, PuliafitoCA, Kumar SR et al. Cystoid macularedema, retinaldetachment, andglugomaaftrNd:YAG laser posterior capsulotomy, *Am J Ophthalmol*, 1991; 112: 373.
8. Petersen AM, Bluth LL, Campion M. Delyed posterior dislocation of silicone plate-haptic lenses after neodymium: yagcapsulotomy. *J Cataract Refract Surg*, 2000; 26: 1827.
9. ChannellMM;, Beckman H. Intraocular pressure changes after neodymium-YAG laserposterior capsulotomy *Arch Ophthalmol*, 2000; 118: 1334.
10. SlomovicAR, ParrishRK. Acute elevation of intraocular pressure following Nd:YAG laser postreiorcapsulotomy. *Ophthalmology*, 1985; 92: 973.
11. Flohr MJ, Robin AL, Kelley JS. Early complication following Nd:YAG laser capsulotomy. *Ophthalmology*, 1985; 92: 360.
12. Steinert RF, PuliafitoCA, Kumar SR et al. Cystoid macularedema, retinaldetachment, andglaucomaafterNd:YAG laser posterior capsulotomy, *Am J Ophthalmol*, 1991; 112: 373.
13. Karahan, E., Tuncer, I., &Zengin, M. O. (2014). The Effect of ND:YAG Laser Posterior Capsulotomy Size on Refraction, Intraocularpressure, Macular Thickness. *Journal of ophthalmology*, 2014; 846385. <https://doi.org/10.1155/2014/846385>
14. Hu, C. Y., Woung, L. C., Wang, M. C., & Jian, J. H. Influence of laser posterior capsulotomy on anterior chamber depth, refraction, and intraocular pressure. *Journal of cataract and refractive surgery*, 2000; 26(8): 1183–1189. [https://doi.org/10.1016/s0886-3350\(00\)00453-3](https://doi.org/10.1016/s0886-3350(00)00453-3).
15. Hayashi, K., Nakao, F., & Hayashi, H. Influence of size of neodymium:yttrium-aluminium-garnet laser posterior capsulotomy on visual function. *Eye (London, England)*, 2010; 24(1): 101–106. <https://doi.org/10.1038/eye.2009.41>
16. Amr, M., El-Emam, S., Eltoukhy, H., & Moussa, M. The effect of Nd : YAG laser posterior capsulotomy size on refraction, intraocular pressure, and central macular thickness. *Tanta Medical Journal*, 2021; 49(1): 24. https://doi.org/10.4103/tmj.tmj_34_21
17. Parajuli A, Joshi P, Subedi P, Pradhan C. Effect of Nd:YAG laser posterior capsulotomy on intraocular pressure, refraction, anterior chamber depth, and macular thickness. *ClinOphthalmol*, Jun. 6, 2019; 13: 945-952. doi: 10.2147/OPTH.S203677 PMID: 31239636; PMCID: PMC6559220.