ORIGINAL ARTICLE

EFFECT OF ND:YAG LASER POSTERIOR CAPSULOTOMY ON THE ANTERIOR CHAMBER DEPTH

Sumera Nisar, Durraiz Rehman*, Areeb Rehman**

Department of Ophthalmology, College of Medicine, Princess Noura Bint Abdulrahman University, Riyadh, *Department of Ophthalmology, Faculty of Medicine Rabigh, King Abdulaziz University Jeddah, **British International School of Jeddah, Saudi Arabia

Background: Cataract is the one of the most common age related, treatable cause of the decreased vision. Cataract is treated by either phacoemulsification or extra capsular cataract extraction. Posterior capsular opacification (PCO) is one the most common delayed complication of the cataract surgery. Nd:YAG laser capsulotomy is the an effective and relatively non-invasive treatment option for the posterior capsular opacification. The Nd:YAG laser has its effects on the anterior camber depth. The objective of this study is to find out the effect of Nd:YAG laser posterior capsulotomy on the anterior chamber depth. **Methodology:** Forty five patients were included and their anterior chamber depths were measured as baseline before the treatment. After that the anterior chamber depths were calculated 1 hour, 1 week and 3 months post treatment. **Results:** The anterior chamber depth decreases following the Nd:YAG laser posterior capsulotomy in 70% of patients. Depth was found to decrease over time. After 1 hour, the change was not statistically significant (p=0.4). In the later follow ups at 1 week and 3 months the anterior chamber depth showed a progressive decrease and the changes were statistically significant (p=0.001). **Conclusions:** Nd:YAG laser posterior capsulotomy leads to significant changes in the anterior chamber depth. The prescription of spectacles should be avoided immediately after the capsulotomy.

Keywords: Anterior chamber, AC, Posterior capsular opacification, PCO, Nd:YAG laser, posterior capsulotomy

Pak J Physiol 2019;15(1):13–5

INTRODUCTION

Posterior capsular opacification (PCO) is the most common delayed complication of extracapsular cataract extraction and phacoemulsification.[1,2] The incidence of PCO is reported to be 20.7% at 2 years and 28.4% at 5 years after cataract surgery.[3] After the pioneering work of Fankhauser *et al*[4] and Aron-Rosa *et al*[5], Nd:YAG laser posterior capsulotomy became the standard procedure to reverse the capsular thickening induced decrease in vision.

Although Nd:YAG laser posterior capsulotomy has been found to be clinically safe and effective, it has the potential to alter the fluid dynamics and positioning of the intraocular lens (IOL) within the eye. Studies have shown subtle posterior shift of the posterior chamber IOL[6] but others failed to observe any such effect[7]. Hence, any significant change in position of the implant can lead to a considerable change in the post-capsulotomy refractive status of anterior chamber depth.[6,7]

This study was performed to determine the changes in anterior chamber depth before procedure, and 1 hour, 1 week, and 3 months after capsulotomy.

MATERIAL AND METHODS

A total of 45 patients (20 eyes of 19 men and 30 eyes of 26 women) with visual deterioration due to PCO were examined in this study. Patients with PCO after phacoemulsification and extracapsular cataract extraction were included in the study. Patients with traumatic cataract surgery and without intra ocular lens implant were excluded.

Patients were selected from the Outpatient Department of Lahore General Hospital, Lahore. The age of the patients ranged from 20 to 70 years (mean age 51±11 years). All capsulotomies were performed by a single surgeon with the Quantum switched Visuals YAG II (Zeiss and Abraham capsulotomy lens, Carl Zeiss, Germany). The posterior capsulotomy was done in a crisscross pattern with an opening of 3.5 to 4.0 mm diameter. Anterior chamber depth was measured by an A scan ultrasound (sensitivity 10 micron) before the capsulotomy, and 1 hour, 1 week, and 3 months after the procedure. Paired Student's t-test was used to compare the data before and after treatment and $p<0.05$ was assumed as significant.

RESULTS

From the total of 45 patients, 50 eyes had PCO with posterior chamber intraocular lens implant. The interval from the cataract extraction to the laser posterior capsulotomy was 18–30 months. The mean energy used for the laser capsulotomy was 27±16 mj and the average number of shots required for the capsulotomy were 13±6. None of the patients had any serious complications after laser therapy.

The anterior chamber depth was found to decrease over time. Depth decreased following the Nd:YAG laser posterior capsulotomy in 70% of

patients. After 1 hour, the change was not statistically significant (p=0.4). In the later follow-ups at 1 week and 3 months the anterior chamber depth showed a progressive decrease and the changes were statistically significant (p=0.001) (Table-1).

Table-1: Depth of the anterior chamber before and after treatment of posterior capsulotomy

	Anterior chamber depth (mm)			
	Before	After treatment		
Analysis	treatment	1 hour	1 week	3 Months
Mean	3.445	3.355	3.199	3.156
Difference	-	-0.095	0.154	0.199
Change (%)	-	-0.689	-5.413	-6.873
***p*-value**	-	0.4	0.001	0.001

DISCUSSION

Cataract is the most common cause of decreased vision in the elderly patients. The only treatment for cataract is the cataract surgery and the most common surgical technique is phacoemulsification with IOL implantation. There are many techniques of phaco-emulsification and many ranges of intraocular lenses. Current cataract surgery strives to create a capsular bag and to keep the posterior capsule intact to support the IOL and sustain the barrier function between the anterior and posterior compartments to prevent retinal detachment and cystoid macular oedema.

As every surgical procedure has its own complications, posterior capsular opacification (PCO) is the most common delayed complication of cataract surgery.[1] The PCO develops in a significant proportion of the patients to such an extent that a secondary loss of vision occurs. The incidence of PCO has been reported to be 20.7% at two years and 28.5% at 5 years after cataract surgery.[2] Nd:YAG laser capsulotomy is accepted as standard treatment for PCO.[3] Although, Nd:YAG laser capsulotomy is a non-invasive and safe treatment, it carries risk of some complications. The Nd:YAG laser procedure can cause temporary inflammation, rise of intraocular pressure and changes in anterior chamber depth. The anterior chamber depth initially decreases to some extent and then with time settles.[8,9] In this study 50 eyes with a wide range of parameters were analysed. The mean time interval from cataract to laser was 18–30 months. The patients were treated irrespective of the type of PCO (elschings pearls or fibrotic variety). To cut the capsule in such variable conditions, the energy required also showed a wide variation (3–140 mj) and the number of shots (2–70 shots) fired to perform the laser. The Nd:YAG laser, when delivered to a minute area for an extremely brief period of time, produces a high electromagnetic field at the focal point. These strip electrons from the atoms at the focal point create plasma in this state of matter with a temperature reaching 15,000 °C.[10] Due to rapid expansion of this plasma, a hypersonic and mechanical shock wave is generated which causes disruption of tissues. This process is called photo disruption.[11] The changes observed in the present study can be correlated with the fact that the modern day YAG laser machine is generally operated in the post focus mode, which means that the plasma stage is generated slightly behind the focused tissue and the resultant shock wave propagates forward to disrupt the tissue. The resultant mechanical effect may be like a push from behind for the lens which might become anteriorly shifted.[12] However, a better method needs to be found to ascertain the position of the IOL to confirm this postulation.

We wanted to see whether this shock wave associated with vitreous herniation causes any shift in the position of the intraocular lens. To facilitate this, we decided to measure the anterior chamber depth before and after laser therapy. Thornval and Naseer[7] found no significant change in anterior chamber depth in their study. These researchers had included corneal thickness in their measurement of anterior chamber depth. However, it is unlikely that there would be a significant change in the cornea induced by laser capsulotomy. Findl *et al*[6] used a dual beam partial coherence interferometer to measure anterior chamber depth and found a subtle backward movement of the IOL with a small hyperopic shift in refraction immediately after laser capsulotomy. The changes were not statistically significant. Early researchers such as Aron-Rosa *et al*[13] did not find any permanent elevation of IOP, but subsequent studies revealed that it might occur. Keates *et al*[14] found elevation of IOP in 0.6% of his patients, whereas Stark *et al*[15] and Chao *et al*[16] reported 1.0% in their study.

We have seen in our study that in the initial phase of Nd:YAG laser capsulotomy the anterior chamber depth decreases. This happens as the post focus of laser beam creates shock wave which causes a resultant mechanical push effect from behind the lens, hence decreases the anterior chamber depth for some time. This decreased anterior chamber depth and associated inflammation adds to the change in refraction before settling down. The refraction remains unstable till 6–12 weeks post laser due to these factors until posterior capsule gets its final position. Therefore, immediate refraction should be avoided after Nd:YAG laser capsulotomy.

CONCLUSION

The anterior chamber depth decreases following capsulotomy for some time. This could result from anterior displacement of IOL or due to the push effect of the shock wave. Therefore, immediate refraction should be avoided after Nd:YAG laser capsulotomy for at least 6–12 weeks.

REFERENCES

1. Sinha R, Shekhar H, Sharma N, Titiyal JS, Vajpayee RB. Posterior capsular opacification. Indian J Ophthalmol 2013;61:371–6.
2. Khambhiphant B, Liumsirijarern C, Saehout P. The effect of Nd:YAG laser treatment of posterior capsule opacification on anterior chamber depth and refraction in pseudophakic eyes. Clin Ophthalmol 2015;9:557–61.
3. Steinert RF. Nd:Yag laser posterior capsulotomy. 2013. Available from: https://www.aao.org/munnerlyn-laser-surgery-center/ndyag-laser-posterior-capsulotomy-3. [Accessed Jun 5, 2019]
4. Fankhauser F, Roussel P, Steffen J, Van der Zypen E, Chrenkova A. Clinical studies on the efficiency of high power laser radiation upon some structures of the anterior segment of the eye. First pathological conditions of the anterior segment of the human eye by means of a Q-switched laser system. Int Ophthalmol 1981;3(3):129–39.
5. Aron-Rosa D, Aron JJ, Grissemann M, Thyzel R. Use of neodymium YAG laser to open the posterior capsule after lens implant surgery. A preliminary report. J Am Intraocular Implant Soc 1980;6:352–4.
6. Findl O, Drexier W, Menapace R, Georgopoulos M, Rainer G, Hitzenberger CK, *et al*. Changes in intraocular lens position after neodymium: YAG capsulotomy. J Cataract Refract Surg 1999;25:659–62.
7. Thornval P, Naeser K. Refraction and anterior chamber depth before and after neodymium: YAG laser treatment for posterior capsular opacification in pseudophakic eyes: a prospective study. J Cataract Refract Srug 1995;21:457–60.
8. Min JK, An JH, Yim JH. A new technique of Nd:YAG laser posterior capsulotomy. Int J Ophthalmol 2014;7(2):345–9.
9. Khan B, Alam M, Shah MA, Bashir B, Iqbal A, Alam A. Complications of Nd:YAG laser capsulotomy. Pak J Ophthalmol 2014;30(3):133–6.
10. Barnes PA, Rieckholf ICE. Laser induced underwater sparks. Appl Phys Lett 1968;13:382–4.
11. Reedy JF (Editor). Effect of high power laser radiation. New York: Academic Press; 1971.
12. Aslam TM, Devlin H, Dhillon B. Use of Nd:YAG laser capsulotomy. Surv Ophthalmol 2003;48:594–12
13. Anan-Rosa D, Aron JJ, Cohn HC. Use of a pulsed picosecond Nd:YAG laser capsulotomy. Am Intraocul Implant Soc 1984;10(1):35–9.
14. Keates RH, Steinert RF, Puliafito CA, Maxwell SK. Long term follow up of Nd:YAG laser capsulotomy:. Am Intraocul Implant Soc J 1984;10(2):164–8.
15. Stark WJ, Worthen D, Holladay JT, Murray G. Neodymium: YAG laser and FDA report. Ophtahlmol 1985;92:209–12.
16. Chao YH, Wong LC, Wang MC, Jian JH. Influence of laser posterior capsulotomy on anterior chamber depth, refraction and intraocular pressure. J Cataract Refract Surg 2000;26:1183–9.

Address for Correspondence:

Dr. Sumera Nisar, Associate Professor and Co-Chair Ophthalmology, College of Medicine, Princess Noura Bint Abdulrahman University, Riyadh, Saudi Arabia.
Email: sumeranisar16@gmail.com.

Received: 24 Jun 2018 **Reviewed: 16 Feb 2019** **Accepted: 9 Mar 2019**