Original Article

Is the Nd: YAG Laser a Safe Procedure for Posterior Capsulotomy?

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Purpose: To evaluate the complications during and following Nd: YAG laser posterior capsulotomy.

Material and Methods: This study was conducted in the department of Ophthalmology Liaquat University of Medical & Health Sciences, Hyderabad, from April 2006 to July 2007. Three hundred and twenty patients with significant PCO, after performing pre-laser assessment were subjected to laser treatment. Nd: YAG laser posterior capsulotomy was carried out with Q-switched, SYL 9000 YAG laser system, under topical anesthesia with Abraham's capsulotomy lens. These patients were assessed for post-laser visual acuity and possible complications just after one hour of laser treatment and at the end of first week, 2nd week and 4th week. The post laser treatment was advised to each patient as needed.

Result: Out of 320 patients 200 (62.5%) were males and 120 (37.50%) were females. The mean time interval between cataract surgery and Nd: YAG laser posterior capsulotomy was 2.5 years. During and following Nd: YAG laser capsulotomy out of 320 patients 30 patients (9.37%) developed intraocular lens (IOL) pitting, ten patients (4.68%) developed rise in intraocular pressure (IOP), two patients (0.62%) showed rupture in anterior vitreous face(AVF), two patients (0.62%) developed cystoids macular edema(CME). The best corrected visual acuity (VA) of 6/9 – 6/6 was achieved in 310 eyes (96.87%); where as only 10 eyes (3.12%) did not have significant improvement in visual acuity.

Conclusion: The Nd: YAG laser capsulotomy is a safe, effective out patient procedure to create an opening in opaque posterior capsule for the improvement in vision.

In last two decades resurgence of refined techniques of extra capsular cataract extraction (ECCE) surgery not only reduced the rate of complications like cystoids macular edema (CME), vitreous loss and retinal detachment (RD) compared to intra-capsular cataract extraction (ICCE) surgery, but the intact posterior capsule also encouraged the implantation of posterior chamber (PC) intraocular lens (IOL) for achieving good vision.

Posterior capsule opacification (PCO) is the most common complication after ECCE surgery[1-3]. Incidence of PCO is about 18% to 50% by two years post operatively[1,14]. It causes reduction in visual acuity (VA) and contrast sensitivity by obstructing the view or by scattering the light that is perceived by patients as glare[1,2,5]. It also decreases the field of view during therapeutic and diagnostic procedures[6], and also causes uni-ocular diplopia[6].

Nd: YAG Laser posterior capsulotomy is the most frequently performed procedure after ECCE surgery because PCO is a natural consequence of ECCE surgery. The use of Nd: YAG Laser for posterior capsulotomy has been gradually replacing surgical capsulotomy[7], because it is safe effective out patient procedure[8,9]. Although cheap and less invasive than surgical capsulotomy this procedure is never the less thought to be associated with numerous complications which are infrequent but most of them have serious implications on the patients vision. These include raised intraocular pressure[10-16], cystoids macular edema[10-12,14,17-20], retinal detachment[11,14,15,18,21] anterior vitreous destruction and opacification[13,22], IOL damage and decentration[10,14,24,25], posterior sub-luxation of IOL into vitreous cavity[24], lowering of endothelial cell count of the cornea[8] and macular haemorrhage[26].

The purpose of our study was to evaluate the complications during and following Nd: YAG Laser posterior capsulotomy in eyes free of pre-existing ocular pathology like glaucoma and diabetic retinopathy that might preclude accurate analysis of post laser complications.

MATERIAL AND METHODS

Three hundred and twenty patients for this quasi experimental study were randomly selected from the out-patients department of Liaquat University of Medical and Health Sciences, Eye Hospital, Hyderabad, from April 2006 to July 2007. Only those patients who had significant PCO and met the following inclusion and exclusion criteria were included.

INCLUSION CRITERIA

1. Elderly patients having uneventful extra capsular cataract extraction (ECCE) with posterior chamber IOL implant.
2. Patients having more than three months follow-up after cataract surgery.
3. Patients having decreased best corrected vision of two or more lines.

EXCLUSION CRITERIA

1. Patients below 15 years of age.
2. Simple extra capsular cataract extraction.
3. Dislocated IOL.
4. IOL implant in traumatic cataract.
5. Patients having combined procedure (Trabeculectomy with PC IOL).
6. Patients diagnosed as a case of diabetic retinopathy or any other retinal disease.
7. Cases with postoperative complications such as endophthalmitis.

The pre-laser best correct visual acuity (BCVA) was assessed with Snellen's chart. On slit lamp examination intraocular pressure with Haag Streit applanation tonometer, anterior and posterior segment abnormal findings were recorded, in all patients on printed proforma.

After performing pre-laser assessment, the patients were subjected to laser treatment. Before treatment 1% tropicamide (Mydriacyl) eye drops were instilled to dilate the pupil and the cornea was anaesthetized with topical application of either 0.5% proparacaine hydrochloride (Alcaine) or 0.4% benoxinate hydrochloride (Novesine) eye drops using Abraham's posterior capsulotomy lens. Q- Switched Nd: YAG laser (SYL9000 YAG laser system) was used to make a hole of 2-3mm in the posterior capsule using 1.5 to 5mJ per pulse. The energy and pulses were increased gradually according to thickness of capsule until an opening was achieved.

Following the capsulotomy 0.1% diclofenic sodium (Naclof) eye drops were advised thrice in a day for one week and antiglaucoma therapy was advised when needed. Then patients were reviewed for assessment of best-corrected visual acuity and for possible complications just one hour after the treatment and at the end of 1st week, 2nd week and 4th week.

RESULTS

Out of 320 patients who underwent Nd: YAG laser posterior capsulotomy, 200 (62.5%) were male and 120 (37.50%) were female (Table-1). The mean time interval between cataract surgery and Nd: YAG laser posterior capsulotomy was 2-5 years (Table-2).

Complications were encountered in 13.8% (44 eyes). This ratio is very small because power setting were very low and we increased the pulses and energy (Table 3) according to thickness of PCO and response in each case.

The number of pulses required in creating an opening in the posterior capsule varied from 3 to 5 and averaged 24 and the energy level ranged from 1.5 to 5 mJ and mean was 3.2 mJ (Table 4). The total energy delivered (total energy = power into total number of pulses) to get a significant opening in the posterior capsule varied between 12 to 180 mJ and averaged 48.8 mJ (Table 4).

Table 1: Gender distribution

Sex	No. of Cases n (%)
Male	200 (62.5)
Female	120 (37.5)
Total	320 (100)

Thirty out of 320 patients (9.4%) developed IOL pitting during laser capsulotomy without significant decrease in VA (Table 5).

Ten out of 320 patients (3.1%) developed raised IOP within 24 hours laser treatment. Post laser IOP measured 8 to 10 mmHg more than normal (Table 5).

Table 2: Time interval between PCO development and Nd: YAG laser treatment

Time interval (Years)	No. of Cases n (%)
01	80 (25)
02	120 (37.5)
03	70 (21.9)
04	50 (15.6)
Total	320 (100)

Table 3: Summary of energy level used for capsulotomy

Energy Level (mJ)	No. of Cases n (%)
1.5 – 2.0	90 (28.1)
2.1 – 2.5	60 (18.8)
2.6 – 3.0	50 (15.6)
3.1 – 3.5	60 (18.8)
3.6 – 4.0	20 (6.3)
4.1 – 4.5	25 (7.8)
4.6 – 5.0	15 (4.7)
Total	320 (100)

Two out of 320 patients (0.6%) showed ruptured anterior vitreous face with forward displacement of vitreous in anterior chamber (AC) between pupil margin and haptic (5.25 mm) of small size IOL (Table 5).

Two patients (0.6%) developed CME especially in those patients who presented early than other cases for Nd: YAG Laser capsulotomy. In these patients the VA was good (6/9) initially but declined gradually to 6/36 (Table 5).

Table 4: Summary of total energy level used for capsulotomy

Energy Level (mJ)	No. of Cases n (%)
12 – 36	96 (30.0)
37 – 60	102 (31.9)
61 – 84	56 (17.5)
85 – 108	40 (12.5)
109 – 132	16 (5.0)
133 – 156	5 (1.6)
157 – 180	5 (1.6)
Total	320 (100)

Table 5: Complications of Nd: Yag Laser

Type	No. of Cases n (%)
IOL Pitting	30 (9.4)
Raised IOP	10 (3.1)
Vitreous in AC	2 (0.6)
Cystoids macular edema	2 (0.6)
Total	44 (13.8)

Table 6: Comparison of pre & post YAG laser visual acuity

Visual Acuity	Pre laser n (%)	Post laser n (%)
CF – 6 / 60	40 (12.5)	05 (1. 6)
6 / 36 – 6 / 24	100 (31.2)	03 (0.9)
6 18 – 6 / 12	180 (50.0)	02 (0.6)
6 / 9 – 6 / 6	00 (0.0)	310 (96.9)
Total	320 (100)	320 (100)

DISCUSSION

Nd: YAG laser posterior capsulotomy is a frequently performed procedure after ECCE surgery because PCO is the most common complication after cataract surgery and more frequent in children and younger adults[27-30] although the latest techniques of cataract surgery are being used.

In the study of 320 cases the time interval between cataract surgery and Nd: YAG laser posterior capsulotomy was 2.5 year (range 1 to 4 years), while it was reported as 2.49 year by Hasan KS, et al[14], and two year in a national study[31].

We know that YAG laser capsulotomy is cheap, effective and safe procedure but not free from complications. During laser treatment complications that we faced were;

1. IOL DAMAGE (IOL Pitting). Hassan KS et al has noted IOL pitting 19.8% in a study of 86 eyes[14] and Haris WS noted 11.7% significant marks on IOL during laser capsulotomy in 342 eyes[32]. These results are comparatively high with our results that were 9.4% (30 eyes) in 320 eyes and none of them accounted for significant visual impairment. The retro-focusing of laser aiming beam can reduce the risk of IOL damage[19] but we observed that in spite of retro focusing the high energy level can damage the low quality IOL.

2. RASIED INTRA OCULAR PRESSURE: The incidence of raised IOP after laser capsulotomy has been documented in the different studies[30,32-35]. Different explanations which have been given for the pressure rise following Nd: YAG laser treatment include the deposition of debris in the trabecular mash work[30,36] pupillary block[37,38], and inflammatory swelling of the ciliary body or iris root associated with angle closure[35].

   One author in a study of laser posterior capsulotomies at Moorfileds eye Hospital London, noted 13 patients to have IOP over 23mmHg and 9 patients to have IOP between 30-48mmHg, within 2-3 hours after laser capsulotomy. In this group of 24 patients there was a tendey for IOP to rise when higher pulse energies were used, particularly when these exceeded 1.5 mj and the raised IOP was generally controlled with antiglaucuma therapy[19]. Hussain MM in his study of 125 eyes treated with Nd: YAG laser for capsulotomy noted 25-30 mmHg rise in IOP in 1.6% cases[13], where Hassan KS et al noted 6 mmHg elevation in IOP after laser capsulotomy, 37.9% in aphakic eyes out of 29 eyes and 16.07% in pseudophakic eyes out of 57 eyes[13]. Average 10 mmHg rise in IOP in one third of patients with Nd: YAG laser has been recorded by some authors[30,34].

   In our study rise in base line IOP was 8-10 mmHg in 10 eyes (3.1%) during 1st 24 hours after laser treatment and all of these reached to normal level within three days with topical betablocker (0.5% timolol meleate) twice a day and oral acetazolamide 250mg thrice a day. In our patients the incidence of elevation in IOP was very low because we used very low energy level and less number of pulses for capsulotomy.

3. RUPTURE OF ANTERIOR VITREOUS FACE (AVF) with forward displacement of vitreous in anterior chamber.
   It has been noted that YAG laser energy focused on the posterior capsule produces liquefaction of vitreous[22], in the same way as occurs if the laser focuses into the mid vitreous. This major change in the vitreous structure provides other mechanisms for dynamic vitreous traction and squeal of retinal breaks and detachments[19].

   Rupture of the AVF permits forward displacement of vitreous in aphakic patients, this may increase dynamic traction on the retina. Forward displacement of vitreous can also be seen in eyes with IOL, a knuckle of vitreous insinuating itself around the IOL and appearing at the pupil margin. This complication may be associated with pupil distortion and IOL displacement. Such event may be the cause of chronic iris irritation and could certainly promote cystoids macular edema[19].

   One author noted 10 out of 24 patients with ruptured AVF after posterior capsulotomy but no vitreous in AC[19], and Haris WS reported vitreous in AC in 15 eyes (4.4%) out of 342 eyes[32]. In this study we noted two cases (0.62%) of ruptured AVF with vitreous in AC, especially in eyes with small haptic IOL. VA was not affected in such cases, however long term follow up is necessary to see the risk of vitro-retinal traction.

4. CYSTOID MACULAR EDEMA: We noted the incidence of CME in two eyes (0.6%), while Hussain MM reported CME 0.8% in the study of 125 pseudophakic eyes treated with Nd: YAG laser capsulotomy[13]. Haris WS noted 16 eyes (4.4%) out of 342 eyes with cystoids macular edema[32].

In such cases the possible mechanism of CME is still unclear but it is suggested that in response to YAG laser the prostaglandin released from anterior segment and reached the retina through vitreous that alters the permeability of paramacular capillaries to develop CME[31]. Continuous iris irritation by displaced vitreous in AC around the pupil margin may promote CME[28]. Delay in Nd: YAG laser capsulotmy by 90 days after cataract surgery allows full recovery of the blood aqueous barrier and can reduce the rate of cystoids macular edema[39].

In our study the best corrected VA of 6/9 - 6/6 was achieved in 310 eyes (96.9%) (Table 6), where as only 10 eyes (3.1%) did not achieve significant improvement in VA because of pre-existing fundus pathology which was not detected due to thick posterior capsule opacification.

As we discussed the incidence of complication during and following Nd: YAG laser but the pathogenesis of most of them yet not clear like CME. Our experience shown that it is un-necessary to use higher energy level, we therefore aimed to achieve satisfactory opening of the posterior capsule while keeping the initial energy setting and amount of total energy used as low as possible. Table 3 and 4 shows that the energy level setting was no higher than 5 mJ and the total energy level used for capsulotomy did not exceed 180 mJ.

The total energy level and retro focusing of aiming beam is the cause of less number of complications in our study, so we can suggest that Nd: YAG laser capsulotomy is a safe and reliable procedure to improve the pre laser visual acuity.

CONCLUSION

The Nd: YAG laser treatment is obviously an effective technique to improve the hindered vision by PCO. It is not free from complications, so it is advised to be conscious of the extra damage to ocular tissues following Nd: YAG laser capsulotomy. It is also suggested that energy level should be kept to a minimum level to avoid severe complications.

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