

## ABSTRACT

**Key Words:** Nd: YAG laser capsulotomy, Cystoid macular edema, Retinal detachment.

## INTRODUCTION:

Cells remaining on the anterior or posterior capsule after removal of the cortex and nucleus. The incidence varies with the age of the patient, difference in surgical technique, design of IOL Implant and period of follow up. In adult its incidence is reported to be 18% to 50% within 3 to 5 five years of surgery<sup>1,2</sup>. There is an age-related tendency towards posterior capsular opacification. In general, older the patient, lesser the incidence. On the other hand incidence is higher in children and young adult. It is 43.5% in infant and juveniles after three months<sup>3</sup> and within two years it approaches to 100%<sup>4</sup>. Although the thickened posterior capsule can be treated by capsulotomy with knife, YAG Laser is preferred because it is less-invasive. In 1980, Aron Rosa first reported the use of Nd: YAG (neodymium-doped yttrium



aluminum garnet) laser to perform posterior capsulotomy<sup>5</sup>. It is reported that this procedure although safe is not 100% free of complications. Following complications are reported in the literature:

- \* Rise of intraocular pressure (IOP) immediately after capsulotomy<sup>6</sup>.
- \* Endothelial damage<sup>7,12</sup>
- \* Anterior uveitis<sup>8,9</sup>
- \* Damage to intraocular lens<sup>10-12</sup>
- \* Rupture of anterior vitreous face<sup>11-14</sup>
- \* Vitreous hemorrhage<sup>15</sup>
- \* Cystoid macular edema<sup>16</sup>
- \* Macular hemorrhage<sup>17</sup>
- \* Macular hole<sup>18</sup>
- \* Retinal detachment<sup>19-21</sup>

## METHODS:

An observational cross-sectional study was conducted in the department of ophthalmology, Khairpur Medical College, Khairpur during 1<sup>st</sup> January to 30<sup>th</sup> of June 2015, on 61 eyes of 60 patients having at least six months' time period after cataract extraction. Evidence of posterior capsule opacification in the form of visual deterioration in the presence of an opacity or lines of tension on posterior capsule visible on slit lamp bio microscopy, mono ocular diplopia or severe glare due to wrinkling of posterior capsule were selected from Eye OPD.

A detailed ocular history was taken including the history of any systemic disease with particular reference to diabetes mellitus, systemic hypertension and any cardiac disease. The ocular examination including visual acuity near and distant pinhole examination with correction and without correction was carried out. Intraocular pressure was checked with applanation tonometer. The posterior capsule was examined for:

1. Stretching and looseness of the capsule.
2. Wrinkles/ tension lines on capsule
3. Types and degree of opacification.
4. Red reflex evaluation which refers illumination to assess the optical significance of capsular opacity.
5. Distant direct ophthalmology at 22cm was carried out to assess the capsular opacity.

The pupil was dilated with 1% mydriacyl and 10% phenylephrine. Fundus was examined and if required the peripheral retina was examined for preexisting pathology.

In cases where no view of funds was available even with indirect ophthalmoscopy ultrasonography by B scan was done to assess the state of vitreous and retina.

After the dilatation of pupil, a drop or two of topical anesthetic were instilled in the eye before the beginning of the procedure. Patient was seated on a chair before the laser slit lamp and we applied the corneal contact lens on the patient's eye. It was tried to use minimum amount of energy necessary to open the capsule. For thin and tense capsule energy setting of 1 to 3 mJ and single shots used. Shots were placed at tension lines which result in the largest opening per shot. An adequate capsulotomy opening was produced with 5 to 20 shots. The energy was gradually increased if opacification was dense and fibrotic.

All the patients remained in the OPD for at least 4 hours for the examination and record of intraocular pressure at ½ hour, one hour, two hours and three hours interval. Visual acuity was taken with and without correction for near and distance. Slit lamp bio microscopy was performed for any corneal lesion (burn) any reaction in anterior chamber or hyphema, condition of iris and pupil, pitting or cracks on IOL in pseudophakic patients and disruption of anterior vitreous face. 90 D examination and indirect ophthalmoscopy was done. Patients were followed up after one week, two weeks, one months, two months, four months and six months interval.

## RESULTS:

This prospective study was done on a total number of 61 eyes of 60 patients. Male were 28 with a male to female ratio of 1:0.9. Pseudophakics were 49 (80.3%) and aphakics were 12 (19.7%). The age of patients ranged from 16-90 years (Table-1). Average age was 56 years. All these 61 capsulotomies were performed for optical purpose.

**Table-I: Age Distribution**

Age Group (Years)	No. of Patients
16-40	07
41-50	16
51-60	23
61-70	10
71-90	04
Total	60



Time interval between cataract surgery and YAG laser capsulotomy was between 6 months to 5 years.

Cases were divided in three different groups according to the level of deterioration of vision.

Groups	Visual Acuity	No. of Eyes	%
Group-I	<6/60	13	21.31
Group-II	6/60 to 6/24	25	40.98
Group-III	> 6/24	23	37.70

20 eyes (32.8%) had their visual acuity improved by 1-3 Snellen lines. 25 eyes (41.0%) had their visual acuity improved by 4-6 lines and 10 eyes (16.4%) had improved their vision by more than 6 lines of Snellen chart (Table II&III). 6 eyes (9.8%) had no improvement in the vision (Table IV).

**Table-II: Pre-YAG Visual Acuity**

Vision	No. of Eyes	%
< 6/60	13	21.3
6/60 - 6/24	25	41.0
> 6/24	23	37.7

**Table-III: Post YAG Visual Acuity**

Visual Improvement	No. of Eyes	%
1-3 Snellen's Line	20	32.8
4-6 lines	25	41.0
> 6 lines	10	16.4
No improvement	6	9.8

**Table-IV: Causes of No Improvement in Visual Acuity of 6 Eyes**

Age Group (Years)	No. of Patients
Retinal Detachment	1
Cystoid Macular Edema	1
Glaucoma	1
High Refractive Error	3

The various complications related to Nd: YAG laser capsulotomy were seen in our study. These complications developed during the procedure and early or late post laser period. These complications and rise in IOP within three hours is mentioned in tables V & VI.

**Table-V: Complications of Nd: YAG Laser Posterior Capsulotomy**

Complications	No. of Patients	%
<b>During Capsulotomy</b>		
Corneal Damage	1	1.6
Damage to IOL (pitting)	10	16.4
Hyphema	1	1.6
Rupture of Anterior Vitreous Face	20	32.8
<b>Early Post Laser (within 24 hours)</b>		
IOP rise < 5mmHg	17	27.9
IOP rise 6mmHg	10	16.4
Anterior Uveitis	4	6.5
<b>Late Post Laser</b>		
Persistent rise in IOP	1	1.6
Cystoid Macular Edema	1	1.6
Retinal Detachment	1	1.6



**Table-VI:** IOP Rise after Nd: YAG Laser Capsulotomy

Rise of IOP (mmHg)	Up to 3 Hours	
	Aphakic	Pseudophakic
3-5	2 (16.4%)	13 (26.3%)
5-10	4 (33.3%)	4 (8.1%)
> 10	1 (8.3%)	1 (2.0%)

**DISCUSSION:**

Popularity of phacoemulsification with intra ocular implant over the recent past, the incidence of posterior capsular opacification is common, The Nd: YAG laser capsulotomy is the standard treatment of posterior capsule opacification now a day.

YAG: Laser is least invasive means of rupturing the posterior capsule<sup>22</sup>. It offers far more safety, eliminates the need for operation and reduces the time required for treatment, and is performed as an outdoor procedure the results are immediate and dramatic.

The earliest capsulotomy was performed 6 months after cataract surgery. The maximum interval between Nd: YAG capsulotomy and cataract extraction was 10 years.

After an interval of more than 6 months it is very easy to perform capsulotomy without disturbing anterior hyaloid face with the result of lower incidence of retinal complication, like cystoid macular edema and retinal detachment<sup>22</sup>.

In our study the patients underwent Nd: YAG laser capsulotomy, only one case developed retinal detachment and one case resulted in development of clinical cystoid macular edema. One case developed glaucoma and three cases resulted in high refractive error.

We used minimum amount of laser energy 1-1.5mJ and was increased gradually according to the thickness of the capsule up to 3mJ.

The mean pulse energy used in our study was 2.4mJ with a range from 1 to 16mJ. The average number of pulse was 25. Compared to study by Kraff, Saunders and Liberman of 118 consecutive Nd: YAG capsulotomies, they reported that the energy level used was 1.7mJ for both the aphakic and pseudophakic groups. The number of pulses required was  $24 \pm 2$  in pseudophakic and  $36 \pm 3$  in aphakic groups<sup>23,24</sup>.

In another study by Slomovic and Parrish, they used mean pulses energy of 0.8mJ (rang 0.5-1.5mg per Pules). While the median number of pulses was 92 (rang 20-970)<sup>25</sup>. The energy setting of our study is quite comparable to some other studies. Kang-Sun Wang, Ming-Heng Zhang and ling Wang reported in their study that they used the energy level of 2-4mJ per pulse. The mean total number of pulses required was 154 with a range from 4 to 616<sup>26</sup>.

Hasan et al in their study of 89 consecutive Nd: YAG laser capsulotomies reported that an average energy required was 2-2.5mJ. Energy was much lower (10-15mJ) for capsule with pearls, than with fibrosis (56.5mJ).

In another study of 96 Nd: YAG Laser capsulotomies by Rahman A 1996, the mean pulse energy used was 3.9 mJ with a range from 1.0 12mJ. The median number of pulses was 116. Geeta R. Shah et al in their study of 3000 Nd: YAG laser capsulotomies reported an average power setting of 3.6mJ on mode locked and 5.0 mJ on Q-switched lasers. The average number of shots for the last 1000 capsulotomies was eight<sup>27</sup>.

By this study it was observed that a typical capsule can easily be opened by using 1-2mJ per pulse. While thick fibrosed capsules requires higher pulses energy from 3 to 5mJ. Capsules which were not perforated with 5mJ energy were left alone for surgical intervention.

Complication during procedure observed were corneal damage, damage to intraocular lens, hyphema, rupture of anterior vitreous face.

Early post laser complication within 1<sup>st</sup> hour to 24 hours, acute rise of intraocular pressure, anterior uveitis, hyphema, herniation, of vitreous through the capsulotomy onto the anterior chamber.

Late post laser complication persistent rise of intraocular pressure, clinical cystoid macular edema and retinal detachment<sup>28</sup>. Nd: YAG Laser capsulotomy increases the risk of retinal detachment. An incidence of 2.4%- 3.2% has been reported in most large series. YAG laser capsulotomy was associated with an increased risk of vitreous hemorrhage<sup>15</sup>. Retinal damage induced by the YAG Laser has been reported in clinical and histopathologic studies. Study of complication of YAG leaser capsulotomy was done in Khyber eye foundation Peshawar by Bilal khan<sup>29</sup> and Mamtazalam 2014 in which damage to



**Table-VII:** Incidence of Complication after Nd: YAG Laser Capsulotomy in Various Studies

Complication	Khyber Eye Foundation Peshawar Khan B et al <sup>29</sup>	MGM Medical Collage Mumbai Gore Vs <sup>31</sup>	JPMC Ankles-ari Jh <sup>12</sup>	CHK Hasan et al <sup>8</sup>	CHK Shaikh Za <sup>9</sup>	Hussain MM <sup>10</sup>	Akhter MS <sup>13</sup>	Present Study
Rise of IOP	8.7%	3.5%	6%	41.9%	29%	1.6%	--	27.8%
Corneal Endothelial Damage	—	1%	2%	—	—	—	—	1.6%
Anterior Uveitis	--	33.5%	--	36%	14%	--	40%	6.5%
Damage to IOL	12.8%	4.5%	2%	19.8%	--	--	--	20.4%
Rupture of Anterior vitreous Face	--	--	--	--	100%	--	45%	32.8%
Cystoid Macular Edema	3.9%	4%	4%	--	2.8%	0.8%	5%	1.6%
Retinal Detachment	0.5	0.5%	2%	2.3%	1.5%	0.8%	--	1.4%

Intraocular lens pitting was (12.81%). Transient rise of IOP was (8.69%) and cystoid macular edema was (3.89%)retinal detachment are (0.45%). A study of Nd: YAG laser capsulotomy and its complication was done at JPMC Karachi in 1998. In this study there was 4% cystoid macular edema, 2% retinal detachment, 6% raised intraocular pressure, 2% corneal endothelial damage and 2% damage to intraocular lens implant (pitting)<sup>12</sup>.

In this study one (1.6%) case accidental damage to cornea occurs. It occurs due to miss focusing of posterior capsule. Corneal damage can occur because of inaccurate focusing of laser beam of due to sudden movement of the patient while laser is being fired. Therefore, apart from accurate focusing, a steady position of the patient on the laser slit lamp is necessary. The head of patient should be maintained by an assistant. Use of contact lens also helps to stabilize the eye.

In current study, out of 49 pseudophakic eyes, IOL damage in the form of pitting or surface marking was seen in 10 (20.4%). There was no

effect on vision due to pitting of IOL.

In the study at civil hospital, Karachi by Hasan KS et al damage to IOL in the form of pitting was 19.8%<sup>8</sup>.

The IOL damage is due to inaccurate focusing of the laser beam either by the misjudgment of the surgeon or as a result of misalignment of aiming beam with the laser beam. Use of high energy, in case of fibrotic capsular opacification also damages IOL.

Presence of scratches or deposits such as fibrin or inflammatory cells on the surface of IOL and close contact of posterior capsule with IOL increase the tendency for IOL damage.

IOL damage mechanism is complex. Mainly hypersonic shock waves are responsible for saucer like cracks in the IOL. Damage to IOL is frequent but is almost always minor. Such damage rarely interferes with vision. The probability of laser damage severe enough to produce visual symptoms proximity of membranes to IOL. This damage occurs in upto 30% of cases. This damage occurs once the critical pulse energy is exceeded



As the source excess energy at the point of focus is dissipated towards the direction of the source rather than laterally i.e., in case of posterior capsular opacification towards the IOL.

If the laser system is not equipped with retro focusing device which automatically focuses the laser beam behind the target focused by the surgeon, the capsule should be focused and the HeNe spots separated slightly by moving the joystick of lamp forward.

Application of laser away from the visual axis reduce the severity of the effect of IOL damage like in racquet shaped capsulotomy<sup>9</sup>.

In our study minor streak hyphema was seen in one (1.63%) case. It was due to accidental damage while laser shots were being applied near pupillary margins. It resolved spontaneously within 24 hours without any sequelae. During Nd: YAG laser capsulotomy hyphema has been reported to occur from accidental iris damage or from of neovascularization on the posterior capsule.

In a study by Latif, E et al 1996, minor hyphema was seen in 24% of their cases, when laser was applied near the margin of the pupil or vascularized membrane<sup>11</sup>.

Uveitis after Nd: YAG posterior capsulotomy is usually mild transient and controlled by topical steroids<sup>8</sup>. In our study 4 (6.5%) cases were found to have anterior uveitis. In study at Bahawal Victoria Hospital by Latif, E et al the anterior uveitis was reported in 5.5% cases<sup>11</sup>. Rupture of anterior vitreous face was Seen in 20 (32.78%) eyes while herniation of vitreous in anterior chamber was seen in 3 (4.9%) all of which were aphakic. Among them one case developed pupillary block glaucoma laser iridotomy and later on trabeculectomy was performed in that case.

In a study at Civil Hospital Karachi, there was 100% anterior vitreous face disturbance<sup>9</sup>.

The incidence of cystoid macular variable is variable 0.8% 10 and 1.23% 87. In another study by Mohammad S. Akhtar incidence of CME was 5%<sup>13</sup>. Emery has reported clinical CME in 1.4% of patient with primary capsulotomy. The incidence of angiographic CME reported by Kraff et al was 5.6% in secondary capsulotomy after 3-6 months following ECCE with intraocular lens implantation<sup>24,29</sup>. In our study, incidence of CME is 1.637% which is comparable to other studies.

Higher incidence of CME has been

Observed in relation to higher number of laser applications and use of high energy setting.

The presence of an intact posterior capsule somehow defers the development of retinal detachment. It is only natural that making an opening in the posterior capsule negates this protective feature and the eye becomes more susceptible to this potentially devastating complication of retinal detachment.

Hussain et al 1996 reported an incidence of 2.3% in their study<sup>8</sup>. Latif and Aasi in their study observed an incidence of 1.4% 11. Hussain MM in 1996 reported an incidence of 0.8%<sup>10</sup>.

In this study, incidence of retinal detachment is 1.63%.

### CONCLUSION:

In spite of few sight-threatening complications Nd: YAG laser is relatively safe and convenient method for doing capsulotomy in posterior capsular opacification, when used with caution.

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