

# Significance of Primary Posterior Capsulotomy using Nd:Yag laser in Pediatric Cataract Surgery

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## Article Information

Received date: Oct 22, 2018

Accepted date: Nov 04, 2018

Published date: Nov 08, 2018

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**Keywords** Developmental Cataract; Capsulotomy; Nd:YAG laser; Capsulorhexis; Anterior Vitrectomy

## Abstract

**Background/Purpose:** To evaluate the effectiveness of primary neodymium-doped yttrium aluminum garnet (Nd:YAG) laser posterior capsulotomy in pediatric cataract surgeries.

**Methods:** Retrospective analyses of 19 eyes of 11 patients with developmental cataract who had undergone cataract surgery between 2012 to 2016 were included in the study. All the cases that had undergone phacoemulsification with foldable acrylic Intra Ocular Lens (IOL) in which the posterior capsule was left intact, and followed by Nd:YAG capsulotomy after one to two weeks of surgery were included. Traumatic cataracts and those which needed anterior vitrectomy due to dehiscence of posterior capsule were excluded from the study.

**Results:** The mean age of the study population was  $7.42 \pm 3.39$  years with minimum age of 3 years and maximum of 14 years. The maximum follow-up period was found to be 33 months. The mean preoperative visual acuity in the study group was 0.87 log MAR units and a statistically significant improvement was noted post operatively. All 19 eyes had a clear visual axis at the last follow up. No eye developed visual axis opacification or required any further intervention.

**Conclusion:** This study proposes that leaving the vitreous undisturbed and performing YAG capsulotomy after two weeks is more effective than a primary posterior capsulorhexis with anterior vitrectomy especially in children older than 3 years. It is a safe and easier method even at the hands of inexperienced surgeons who may have to take up a developmental cataract in under developed and less accessible parts of the world.

## Introduction

Pediatric cataract is an important and preventable cause of blindness. Congenital cataracts are responsible for about 5 to 20% of blindness in children worldwide. The overall prevalence of childhood cataract and congenital cataract ranges from 0.32 to 22.9 per 10000 children and 0.63 to 9.74 per 10000 respectively. The incidence ranges from 1.8 to 3.6 per 10000 per year [1]. Pediatric cataracts are classified into congenital, developmental and traumatic. Congenital cataracts present within the first year of life whereas developmental cataracts present after infancy. The management of pediatric cataract varies in each case depending on the morphology, density, location and the laterality of the cataract and is not only dependent on the age at presentation.

Surgical treatment is not indicated in all pediatric cataracts. If the opacities are punctate with clear cortex in between and allow maintaining a reasonably good vision, the surgical management can be delayed. The child can be prescribed mydriatics if required and has to be followed up carefully, monitoring the visual acuity as well as the progression of the cataract [2,3]. Cataracts which are dense enough or which are in the central visual axis can interfere with the proper development of the sensory visual pathway in children. Hence these type of cataracts have to be managed early. Extraction of unilateral cataracts is advised within 4-6 weeks and bilateral cataracts within 6-8 weeks of life to prevent amblyopia and strabismus [4,5]. Stimulus deprivation amblyopia may be irreversible if not treated sufficiently early. The critical steps in the management of pediatric cataract that determines the visual outcome are an early diagnosis, adequate surgical procedure, and aggressive amblyopia therapy.

Pediatric cataract surgeries differ from adults and are more challenging as they have a thinner and less rigid sclera and a very elastic lens capsule. Moreover, there are increased chances of developing severe inflammatory response after surgery in young age [6,7]. Superior scleral incisions are preferred commonly by most surgeons. Anterior capsulotomy techniques include a continuous curvilinear capsulorhexis manually or vitrectorhexis or radiofrequency diathermy. Lens removal can be done by manual irrigation and aspiration (as these cataracts are very soft) or using phacoemulsification. The management of posterior capsule after cataract extraction is important as posterior capsular opacification in later stages lead to amblyopia. Posterior capsulorhexis with anterior vitrectomy is being considered as the gold standard in the management of pediatric cataract [8]. Leaving the posterior capsule intact has been found to be associated with high rates of posterior

capsular opacification [8]. Many surgeons, however, do not perform anterior vitrectomy for older children [9]. Long term complications like cystoid macular edema are more likely after vitrectomy [10]. The chances of formation of inflammatory membrane and vitritis are also high following disturbance of vitreous [11]. In 1994, Atkinson and Hiles [12] had reported leaving the posterior capsule intact and performing neodymium-doped yttrium aluminum garnet (Nd:YAG) laser capsulotomy under a second general anesthesia in the early postoperative period. They had used H.S. Meridian Microruptor III Nd:YAG laser which is mounted vertically to be used in supine position in operating theatre. These instruments are rarely manufactured and used today.

In this work, the post-operative complications and visual axis opacification in children older than three years were evaluated. These subjects were in whom a primary posterior capsulorhexis and anterior vitrectomy during surgery was avoided and a Nd:YAG capsulotomy between one to two weeks after surgery was performed when the eye was quite.

## Materials and Methods

The study comprised retrospective evaluation of 19 eyes of 11 patients with developmental cataract who had undergone cataract surgery from 2010 to 2016. Institutional Review Board (IRB) approval was obtained before starting the study. Ten out of the 11 patients had bilateral cataract of which 2 patients had already undergone surgery in one eye elsewhere. Mean age of the children was  $7.42 \pm 3.39$  years. Complete ocular examination was performed in all the cases. All surgeries were done by a single surgeon. All the patients underwent surgery under general anesthesia. Scleral tunnel incision was done in all cases and anterior capsulotomy was done using cystotome canula or irrigation aspiration mode of phacoemulsification. AcrySof IQ posterior chamber Intra Ocular Lens (IOL) was used in all except one case in which Matrix Acrylic three piece IOL was used. This patient had a history of trauma. Hence the surgeon felt a possibility of PC rupture during surgery and a 3 piece IOL was chosen. Posterior capsulorhexis and vitrectomy were not done in any case. All eyes were treated with antibiotics and steroids topically for 6 weeks in a tapering dose and cyclopentolate for 2 weeks. A low potent steroid loteprednol was used topically to prevent occurrence of steroid induced glaucoma and systemic steroids were used as per body weight as an anti-inflammatory.

Nd:YAG laser capsulotomy was performed for all eyes in a period between one to two weeks following surgery. As the post-operative inflammatory response is minimal during this period and the PC will be thin and a minimal energy is sufficient for a capsulotomy, the surgeon felt this to be an appropriate period. A complete slit lamp examination, fundus examination with 90 D and indirect ophthalmoscopy was done prior to the procedure. Intra Ocular Pressure (IOP) was always checked prior to the procedure. The need and nature of the procedure was explained to the parents and informed consent was obtained. YAG capsulotomy was performed under topical anaesthesia with xylocaine jelly in cooperative patients and syrup Triclofos was used in children less than 5 years who were not cooperative. The duration of the procedure was between 2 - 5 minutes. The pupil was dilated before procedure and an Abraham lens was used. The average YAG laser intensity needed was 2 mj

per pulse. As stated by Arbisser [13] the size of the capsulotomy opening was always made larger than the size of the optics of the IOL. Hanging fragments were avoided by making a regular uniform opening because they can remain and cause visual interference. One drop of brimonidine was instilled immediately after the procedure. The average rise in IOP was found to be 5mm Hg. IOP was again measured after 4 hours and was always found to be within normal range. After the capsulotomy, all patients were reviewed the next day and after one week.

## Results

The study group consisted of 19 eyes of 11 patients of which 12 were males and 7 were females. Mean age of the study population was  $7.42 \pm 3.39$  years with minimum age of 3 years and maximum of 14 years. Mean age of males and females were  $8.42 \pm 3.6$  years and  $5.71 \pm 2.3$  years respectively. The target refraction for children < 2 years, 2-5 years and > 5 years were fixed at 20%, 15-20%, and 10-15% of under correction respectively. The mean axial length of the study group was  $23.06 \pm 1.33$  mm with minimum of 19.3 mm and maximum of 24.48 mm. The mean IOL power was  $20.28 \pm 4.97$ D with minimum of 12D and maximum of 28.5D. The contact A-scan method was performed in cooperative children and on table immersion ultrasound A-scan method was performed for children who are not cooperative. Hoffer Q formula was used to calculate IOL power for the axial lengths < 22 mm and SRK/T formula was used for the axial lengths of 22-24.5mm. The IOL power implanted was adjusted for age according to standard protocol. All the patients were followed up at 1 week and 1 month. Few patients were lost to follow up after one month. The mean follow up period for remaining patients after 1 month was at 8.54, 19.42, 26.6 and 37.58 months for the third, fourth, fifth and sixth follow up respectively. The maximum follow up period was found to be 42 months. The details of follow up visits along with the number of eyes are given in Table 1.

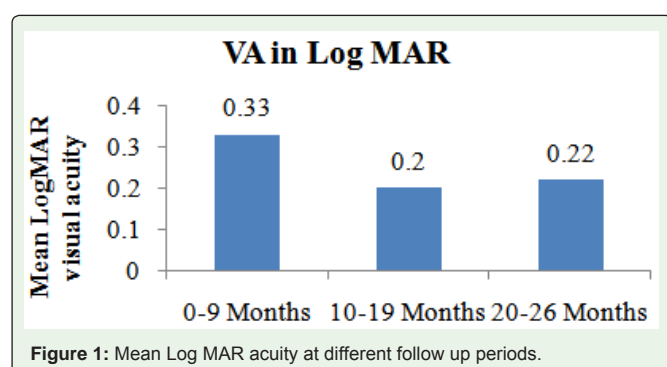
The mean preoperative visual acuity in the study group was 0.87 log MAR units. The mean visual acuity at each follow up visit is calculated (Table 2). The follow up visits are further divided into 3 time periods of 0-9, 10-19 and 20-26 months. At each visit, a statistically significant improvement in the Log MAR visual acuity post operatively was noted with a p value of less than 0.05 and is shown in Figure 1. Refraction was done for all patients at 1 month review. The mean spherical equivalent was found to be  $+0.50 \pm 1.24$  D with a minimum of -0.75 D and maximum of +2.6 D. The mean cylinder was found to be  $1.225 \pm 0.78$  DC with a range of -2.00 D to zero. The mean postoperative visual acuity for the children < 5 years and > 5 years of age was found to be 0.16 and 0.20 Log MAR units and was found to be statistically insignificant with  $p > 0.05$ .

**Table 1:** Showing number of eyes followed up in each visit.

FOLLOW UP	NUMBER OF EYES
1 <sup>st</sup> visit	19
2 <sup>nd</sup> visit	19
3 <sup>rd</sup> visit	14
4 <sup>th</sup> visit	7
5 <sup>th</sup> visit	4
6 <sup>th</sup> visit	2

**Table 2:** Showing mean visual acuity in log MAR at each follow up.

VISIT	VA in Log MAR
PREOP	0.87
1 <sup>st</sup> visit	0.38
2 <sup>nd</sup> visit	0.31
3 <sup>rd</sup> visit	0.21
4 <sup>th</sup> visit	0.29
5 <sup>th</sup> visit	0.19
6 <sup>th</sup> visit	0.21



All 19 eyes had a clear visual axis at last follow up. No eye developed posterior capsular opacification or required any further procedure. None of the eyes had any complications like posterior synechiae formation, glaucoma, cystoid macular edema or retinal detachment. There was zero percentage incidence of visual axis opacification in the study group.

## Discussion

There are different methods for management of posterior capsule in a pediatric cataract. Posterior capsulorhexis with anterior vitrectomy has been considered as the best option. Primary posterior capsulorhexis during cataract surgery is usually done manually or using diathermy or vitrectomy probe followed by anterior vitrectomy. Posterior Continuous Curvilinear Capsulorhexis (PCCC) is a difficult procedure to perform for most surgeons and requires much expertise. First step to perform a manual PCCC is filling the capsular bag with viscoelastic. Using cystitome posterior capsule is ripped from center towards periphery and completed with utrata forceps by frequent grasping and regrasping. The diameter of PCCC is usually kept less than that of anterior capsulorhexis. Vitreous face disruption is the main complication while doing a PCCC. Vitreous disturbance is recognized by pupil or rhexis margin deformation or by visible strands of vitreous. Howard V. Gimbel and Abhay R. Vasavada [13] stated preserving the anterior vitreous face without a vitrectomy helps in avoiding future retinal complications in children. Hence anNd:YAG capsulotomy after one to two weeks' time instead of a PCCC was opted.

The incidence of Posterior Capsular Opacification (PCO) when the posterior capsule is left intact is reported between 42 to 100 percent in various studies [14,15]. Studies [16-18] have also been done where posterior capsulorhexis was done without anterior vitrectomy

and were found to be safe and effective in older children. In addition to age, material of IOL used has also shown to affect the occurrence of PCO. Hydrophobic acrylic lenses are found to reduce the rate of PCO [19].

The risk of post-operative complications is higher in paediatric age group due to greater inflammatory response after surgery [7,20]. Paediatric cataract surgery is associated with a higher incidence of uveal inflammatory reaction. Petric et al. [21] noted higher incidence of uveal inflammatory reaction in the group with posterior capsule opacification and vitrectomy, which was attributed to the age of the patients. Postoperative complications, such as inflammatory response, may contribute to visual axis obstruction. Vasavada et al. [22] reported posterior synechia formation in 34.6% of eyes where posterior capsulorhexis with anterior vitrectomy was done. Sharma et al. [23] reported the sequelae of uveitis (posterior synechia and intraocular lens deposits) in one-third of the eyes in a study that included traumatic paediatric cataract and implanted PMMA intraocular lens.

Posterior capsulorhexis during surgery provides a route of spread of inflammatory response to the anterior vitreous which enhances the proliferation of lens epithelial cells onto anterior vitreous surface and lead to opacification of visual axis [21]. Hence we left the posterior capsule intact during surgery and did anNd:YAG capsulotomy only after the eyes were quite with no cells and only minimal flare.

Nd:YAG laser posterior capsulotomy is a relatively safe technique of opening the posterior capsule with a short, high-power pulse. The minimal amount of energy necessary to rupture the capsule is used. With most lasers, the capsule can be opened by using 1 to 2 mJ/pulse. The capsule is examined for tension lines. Shots are placed across tension lines. This results in larger opening per pulse because the tension causes the initial opening to widen. The capsulotomy is done in a cruciate pattern. Minimal amount of energy must be employed carefully so that pits and cracks are avoided on the IOL. The capsulotomy should be as large as the pupil in isotopic conditions [24].

Our results showed promising data that visual axis opacification was never encountered when posterior capsule was left intact during surgery and followed with YAG capsulotomy within two weeks' time in children more than 3 years of age. Despite the smaller number of patients and a limited period of follow up our study provides valuable and promising information. However a longer follow up in a larger study population would be needed to further evaluate the efficacy of YAG capsulotomy over conventional posterior capsulotomy with anterior vitrectomy in pediatric age group.

## Conclusion

Posterior capsulorhexis with anterior vitrectomy remains the preferred choice in younger children less than 3 years but needs greater surgical expertise. Prolonged surgical time, risk of cystoid macular edema, chances of vitreous loss through surgical wound and retinal detachment are the major drawbacks especially in the hands of inexperienced surgeons. Hence leaving the vitreous undisturbed and performing a YAG capsulotomy is proposed which is safer than a primary surgical posterior capsulorhexis with anterior vitrectomy especially in older children more than 3 years.

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