

Surgical Outcome of Paediatric Cataract Surgery Comparing Hydrophobic vs PMMA Lens

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ABSTRACT:

INTRODUCTION: Paediatric cataract is the opacification of the lens and its capsule in children. Childhood blindness is one of the priority eye diseases within the disease-control strategy of the 'VISION 2020' initiative. The study was conducted to find out whether PMMA lens can be used as a cheaper alternative to hydrophobic lens for paediatric cataract.

METHOD: In a randomized clinical trial 110 eyes of patients with age less than 15 years were included. Indications included congenital, developmental, traumatic, posterior polar, posterior sub capsular cataracts. 55 of them underwent primary lens aspiration with PMMA lens implantation and 55 underwent phacoaspiration with acrylic hydrophobic lens implantation. In all the cases posterior capsulotomy and anterior vitrectomy was done. All the cases were followed postoperatively, in 4 weeks, 3 months and best corrected visual acuity measured at 6 months, cylindrical refractive error and the complications were noted and compared between the two groups..

RESULT: In the PMMA group the mean age of presentation was 8.2 ± 4.06 years out of which 35(63.7%) were males and 20(36.3%) females. Mean age of presentation in hydrophobic group was 9.9 ± 3.06 years with 30(54.5%) males and 25(45.5%) females. The number of developmental cataracts and congenital cataracts in PMMA group and hydrophobic group were 25(45.45%), 24(43.63%) and 40(72.23%), 8(14.55%) respectively. Pre operatively VA ranged from fixation of light to 6/18 in the hydrophobic group and fixation of light and 6/24 in the PMMA group. PMMA group had 20(36%) cases whose BCVA was in the range of 6/6/ to 6/18 while the hydrophobic group had 37(67%) cases in this range. Mean cylindrical error in PMMA group was 1.39 ± 0.56 D and in the hydrophobic group was 1.08 ± 0.65 D.

CONCLUSION: Pediatric cataract surgery results in a good visual outcome if surgery is conducted on time and proper refractive and amblyopia therapy is done. Late presentation of patients is a concern which can be handled by spreading awareness. It is suggested that hydrophobic lens has better postoperative visual acuity and lesser cylindrical error as compared to PMMA lens.

KEY WORDS: Hydrophobic lens, Paediatric cataract, Poly methyl methacrylate lens.

INTRODUCTION

Paediatric cataract is the opacification of the lens and its capsule in children. Childhood blindness is one of the priority eye diseases within the disease-control strategy of the 'VISION 2020' initiative.¹

A child becomes bilaterally blind every minute, primarily within developing nations. Of the 1.5 million blind children in the world, 1.3 million live in Asia and Africa, and 75% of all causes are preventable or curable. The prevalence of blindness varies according to the socioeconomic development of the country and the mortality rate of those under 5 years of age. In developing countries the rate of blindness can be as high as 1.5 per 1000 population.²

Paediatric cataract blindness presents an enormous problem to developing countries in terms of human morbidity, economic loss, and social burden. Managing cataracts in children remains a challenge: treatment is often difficult, tedious, and requires a dedicated team effort. It is imperative to ascertain the indications and timing of the surgery and keep in mind

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the differences between adult and paediatric cataract surgeries. To assure the best long term outcome for cataract blind children, appropriate paediatric surgical techniques need to be defined and adopted by ophthalmic surgeons of developing countries. The high cost of operative equipment and the uneven world distribution of ophthalmologists, paediatricians, and anaesthetists create unique challenges.

Advances in surgical techniques have resulted in a decrease in the incidence of complications³. Many authors support early primary intraocular lens (IOL) implantation in the first year of life for aphakia correction in children^(3, 4). The goal is to decrease amblyopia and strabismus⁵

The purpose of this study is to compare the visual outcome, complication rate and post operative retinoscopic findings between cases which were managed with lens aspiration with posterior capsulotomy and anterior vitrectomy with PMMA lens implantation and phacoemulsification with posterior capsulotomy and anterior vitrectomy and foldable acrylic hydrophobic lens.

METHOD

This was a randomized clinical trial included 110 eyes of patients aged 1 to 15 years with unilateral or bilateral congenital or developmental cataracts. The eyes were randomly assigned to two groups (55 eyes each) to undergo implantation of a foldable acrylic IOL with 6 mm optic and overall diameter of 12 mm, or a single piece PMMA IOL with 6.5 mm optic and overall diameter of 13 mm.

The following inclusion criteria were applied:

- Age: Less than 15 years
- Patients with paediatric cataract,
- Congenital cataract and developmental cataract were distinguished by their age of onset and presence of nystagmus

following exclusion criteria were applied:

- Corneal disease (Fuchs' endothelial dystrophy; corneal stromal scarring)
- Chronic anterior uveitis
- Intraocular pressure >21 mm Hg
- Paediatric cataract associated with any other ocular disease,

- Age more than 15 years
- NPL eye
- Patients with excentric fixation
- For phacoemulsification and foldable lens: patients with posterior polar cataract and large posterior capsular tear and traumatic cataract.

Patients were followed up on 4 weeks, 3 months and 6 months.

All patients underwent a detailed preoperative evaluation. Visual acuity was determined using standard E-chart when feasible; KAY PIC, fixation patterns were noted in preverbal/uncooperative children. Special attention was paid to the presence of nystagmus, amblyopia or strabismus. When necessary, an examination under general anesthesia was carried out. Intraocular pressure (IOP) was measured in suspected glaucoma cases in smaller child and all cooperating older children with either the Perkins applanation tonometer or the Schiotz hand-held tonometer. Biometric measurements were performed by conventional keratometry and hand held keratometer for patients who didn't cooperate. Axial length was measured via a standard contact technique using A-scan ultrasonography in cooperating patients and under general anesthesia for uncooperative patients. IOL power calculations were performed using the SRKII formula⁶ in all cases. The IOL power was adjusted according to patient age (Table 1) to achieve postoperative hypermetropia in order to counterbalance the myopic shift in pseudophakic pediatric eyes.⁷ Other routine ocular examinations included assessment of pupil dilatation, funduscopy and B-scan ultrasonography if necessary.

Table 1: Age-adjusted target hypermetropia

| Age(years) | Target Hypermetropia |
|------------|----------------------|
| 1-3 | 5 Dioptres |
| 3-5 | 3.5 Dioptres |
| >5 | 2 Dioptres |

Surgical Technique

All operations were performed under general anesthesia using a standard technique by a single experienced paediatric ophthalmologist. A wire lid speculum was inserted. The conjunctiva was opened at the limbus for 3 clock hours superiorly. A partial thickness scleral groove 6.5 mm in length was made 2 mm posterior to the limbus. A crescent was used to

create a scleral tunnel anteriorly until clear cornea was reached. A 2.7mm keratome blade was used to enter the anterior chamber in the center of the tunnel. A paracentesis site was also fashioned in the tunnel at 9 clock hours. For the acrylic IOL group, a superior temporal clear corneal tunnel incision was made with a 2.7mm keratome and a paracentesis site was made 3 clock hours apart.

In all cases anterior capsulotomy was performed using a capsulorhexis forceps, moved in a circular motion to create a 4–5 mm opening. After performing anterior capsulotomy, hydrodissection and delineation was performed using a hydro canula and irrigation/aspiration simcoe cannula was used to remove cortical and nuclear materials. Viscoelastic was used to inflate the capsular bag and fill the anterior chamber. Posterior capsulotomy of at least 2.5-3.5 mm in diameter was done and adequate anterior vitrectomy was performed in patients less than 8 years and in all patients with nystagmus. In patients aged more than 8 years of age posterior capsulotomy was not done.

The foldable acrylic IOL was folded longitudinally with forceps and implanted into the capsular bag.

After IOL implantation, viscoelastic material was carefully removed from the anterior chamber and the capsular bag. Globe contour and anterior chamber was maintained by irrigating the side port. In the PMMA group, the limbal groove was opened and the IOL was inserted within the capsular bag. In patients with large posterior polar and preexisting posterior capsular defect the lens was placed in the sulcus. After complete removal of viscoelastic material, the limbal incision was closed using 1-3 separate 10/0 nylon sutures.

SPSS 20 was used for statistical analysis.

Sampling method- Non random sampling.

RESULT

Overall 55 eyes were included each from SICS with PMMA lens group and Phacoemulsification with acrylic hydrophobic lens group. Out of the total cases from the PMMA group 35 (63.7%) were males and 20(36.3%) were females with a mean age of 8.2 ± 4.06 (range 4.14-12.26) years. In the hydrophobic group out of the total 55 cases, 30 (54.5%) were males and 25 (45.5%) were females with a mean age of 9.9 ± 3.06 (range 6.84-12.96) years.

Table 2. Age of patients

| Age (years) | HYDROPHOBIC | | PMMA | | CHI SQUARE | P VALUE |
|-------------|-------------|----------|--------|----------|------------|----------|
| | NUMBER | PERCENT | NUMBER | PERCENT | | |
| <4 | 1 | 1.818182 | 14 | 25.45455 | 14.669 | 0.005439 |
| 5-7 | 14 | 25.45455 | 11 | 20 | | |
| 8-10 | 19 | 34.54545 | 15 | 27.27273 | | |
| 11-13 | 11 | 20 | 11 | 20 | | |
| 14-16 | 10 | 18.18182 | 4 | 7.272727 | | |
| TOTAL | 55 | 100 | 55 | 100 | | |

Table 3. Gender distribution

| GENDER | HYDROPHOBIC | | PMMA | | CHI SQUARE | P VALUE |
|--------|-------------|----------|--------|----------|------------|---------|
| | NUMBER | PERCENT | NUMBER | PERCENT | | |
| MALE | 30 | 54.54545 | 35 | 63.63636 | 0.94 | 0.3322 |
| FEMALE | 25 | 45.45455 | 20 | 36.36364 | | |
| TOTAL | 55 | 100 | 55 | 100 | | |

The PMMA group had approximately equal number of developmental (25-45.45%) and congenital (24-43.63%) and 3(5.5%), 2(3.63%), 1(1.8%) respectively of traumatic, posterior polar and posterior subcapsular cataracts. In comparison with the hydrophobic group,

the number of developmental cataracts were much higher 40(72.73%) as compared to 8(14.55%) of congenital cataracts, 2(3.63%) traumatic, 2(3.63%) posterior polar and 3(5.45%) posterior subcapsular cataracts.

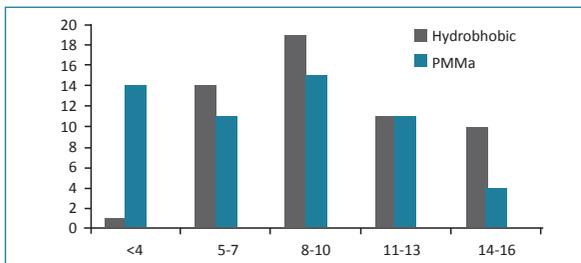


Figure 1

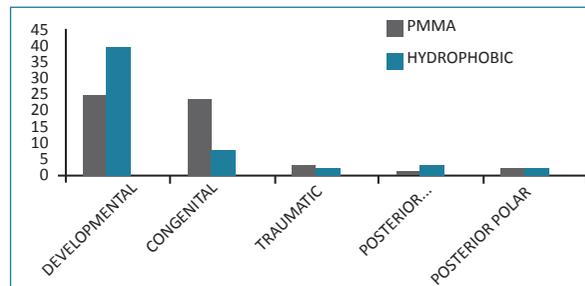


Figure 2

Table 4 Type of cataract

| TYPE OF CATERACT | HYDROPHOBIC | | PMMA | | CHI SQUARE | P VALUE |
|-----------------------|-------------|----------|--------|----------|------------|---------|
| | NUMBER | PERCENT | NUMBER | PERCENT | | |
| DEVELPMENTAL | 25 | 45.45455 | 40 | 72.72727 | 12.662 | 0.01305 |
| CONGENITAL | 24 | 43.63636 | 8 | 14.54545 | | |
| TRAUMATIC | 3 | 5.454545 | 2 | 3.636364 | | |
| POSTERIOR SUBCAPSULAR | 1 | 1.818182 | 3 | 5.454545 | | |
| POSTERIOR POLAR | 2 | 3.636364 | 2 | 3.636364 | | |
| TOTAL | 55 | 100 | 55 | 100 | | |

Preoperatively the visual acuity ranged from fixation of light to 6/18 in the hydrophobic group and fixation of light to 6/24 in the PMMA group. The patient was followed up for 6 months and the BCVA was noted on the 6 months visit. The PMMA group had a BCVA of 20(36%) cases in the range of 6/6-6/18, 10(18%) cases in the range of 6/24-6/60, 18(33%) cases in 6/60-3/60 range, 2(4%) cases in the less then 3/60 group and 5(9%) cases had fixation of light. On the other hand hydrophobic group had a BCVA of 37(67%) cases in the range of 6/6-6/18, 13(23%) cases in the range of 6/24-6/60, 2(4%) cases in 6/60-3/60 range, 2(4%) cases in the less then 3/60 range and 2(4%) cases had fixation of light.

Table 5. Visual acuity in PMMA and Hydrophobic group

| | VISUAL ACUITY | PREOP | | 4weeks | | 3months | | BCVA(6 months) | |
|---------------|-------------------|--------|------------|------------|------------|-----------|------------|----------------|------------|
| | | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage |
| PMMA | 6/6 - 6/18 | 0 | 0 | 10 | 18.18182 | 15 | 27.27273 | 20 | 36.36364 |
| | 6/24 - 6/60 | 5 | 9.090909 | 15 | 27.27273 | 12 | 21.81818 | 10 | 18.18182 |
| | <6/60 - 3/60 | 12 | 21.81818 | 4 | 7.272727 | 14 | 25.45455 | 18 | 32.72727 |
| | <3/60 | 21 | 38.18182 | 9 | 16.36364 | 4 | 7.272727 | 2 | 3.636364 |
| | FIXATION OF LIGHT | 17 | 30.90909 | 17 | 30.90909 | 10 | 18.18182 | 5 | 9.090909 |
| HYDRO-PHOBOIC | 6/6 - 6/18 | 1 | 1.818182 | 26 | 47.27273 | 32 | 58.18182 | 37 | 67.27273 |
| | 6/24 - 6/60 | 7 | 12.72727 | 23 | 41.81818 | 18 | 32.72727 | 13 | 23.63636 |
| | <6/60 - 3/60 | 16 | 29.09091 | 1 | 1.818182 | 1 | 1.818182 | 2 | 3.636364 |
| | <3/60 | 28 | 50.90909 | 4 | 7.272727 | 3 | 5.454545 | 2 | 3.636364 |
| | FIXATION OF LIGHT | 3 | 5.454545 | 1 | 1.818182 | 1 | 1.818182 | 1 | 1.818182 |
| CHI SQUARE | | 12.705 | | 26.741 | | 26.122 | | 20.928 | |
| P VALUE | | 0.0128 | | 0.00002243 | | 0.0000299 | | 0.00032725 | |

All the pre operative, 4 weeks, 3 months and BCVA at 6 months values are statistically significant when compared between PMMA and hydrophobic groups. The percentage of fixation of light is higher in the PMMA group with 30.909 % where is in hydrophobic group it is just 5.45%. The proportion of 6/6 - 6/18 is higher in the Hydrophobic group with a proportion of

67 percent as opposed to 36 % in the PMMA group .The 6/6 - 6/18 is actually higher in the hydrophobic group in all the time periods.

When the cylindrical error was assessed in both the groups 6months postoperatively, the PMMA group had a mean error of 1.39±0.56 D and in the hydrophobic group was 1.08±0.65 D.

Table 6 Astigmatism in PMMA and Hydrophobic groups

| | HYDROPHOBIC | | PMMA | | CHI SQUARE | P VALUE |
|-----------|-------------|----------|--------|----------|------------|---------|
| | NUMBER | PERCENT | NUMBER | PERCENT | | |
| >+2 to +3 | 0 | 0 | 1 | 1.818182 | 18.076 | 0.00604 |
| >+1 to +2 | 11 | 20 | 13 | 23.63636 | | |
| +1 to 0 | 18 | 32.72727 | 4 | 7.272727 | | |
| 0 | 5 | 9.090909 | 10 | 18.18182 | | |
| 0 to -1 | 15 | 27.27273 | 10 | 18.18182 | | |
| >-1 to -2 | 5 | 9.090909 | 15 | 27.27273 | | |
| >-2 to -3 | 1 | 1.818182 | 2 | 3.636364 | | |
| TOTAL | 55 | 100 | 55 | 100 | | |

In the hydrophobic group cylindrical error in 38 Patients (68%) were in the range of +1 to -1 D while the PMMA group had 24 (43%) in this range.

Complications in both the group were very less with only 2 cases with PCO and 2 cases with optic capture in the PMMA .The hydrophobic group had relatively no complications with just one case had corneal edema.

DISCUSSION

The aim of this study was to study the outcome of paediatric cataract surgeries in R.M.Kedia eye hospital which is a premier centre for paediatric cataract surgery in Nepal. The parameters which were measured were the demographic profile of patients, the visual outcome after surgery, the mean cylindrical power after the surgery and the complications during and after the surgery.

Most of the cases which underwent phacoemulsification and hydrophobic lens implantation were greater 4 years of age maximum, 23 being in the age group of 5 -10 years and only one case less than 4 years. The PMMA group had 14 cases under the age of 4 years and cases in the rest of the groups were comparable to the hydrophobic group. The average age of presentation in hydrophobic group was 9.9 ± 3.06 years and in the PMMA group was 8.2 ± 4.06 years which were comparable. In similar studies done by Michael Kuchle Et al ⁸ mean age at surgery was comparable in the two groups: 8.6 ± 4.6 years (age range 3.3–16.8 years) in the acrylic group vs. 6.3 ± 4.3 years (age range 1–16.4 years) in the PMMA group ($p=0.84$). The preference of surgeon to undergo SICS and PMMA lens implantation in younger children was due to the fact that posterior capsule of younger children is thin as compared to older children and during the posterior capsulotomy it may extend more than the required 2.5-3.5 mm. This may cause the

single piece foldable lens of lesser diameter to displace from its place and cause further complications. On the other hand PMMA lens is more stable in this condition. More number of congenital cataracts (25) in PMMA groups can also be explained due to this. On the other hand developmental cataract was the main cause for cataract surgeries in hydrophobic group.

Late presentation of cataracts is also of a concern especially in congenital cataracts which is shown by 8.2 years being the average age of presentation in the PMMA group. Similar results have been noticed by studies conducted in Tilganga institute of ophthalmology Nepal. In this study about one third (32%) presented within the age of three years where as more than two-fifths (46%) presented at the age eight years and above⁹. In similar studies done in Nepal earlier, the mean age of presentation was 6.2 years.¹⁰

Late presentation can be attributed to the poor socio economic status, lack of proper eye care facility specially for children and most of all lack of awareness among the people regarding the seriousness of the problem and how early treatment can make the future life of child much better.

Most of the cases in our study 65(59%) were male as compared to 45(41%) females .Though there is not much difference as compared to other studies seen in Nepal and few other studies across the world.^{2, 4} It has been debated that male child being the more privileged get the facilities much more than the females, but the greater number of females in our study indicate that girls fare much better in this region of Nepal as compared to some other areas. This could also be a paradox as the urgency in proper care in this region could be attributed to the social stigma of the family to keep the girl healthy so that she doesn't have any problems during the marriage. This reason though

not a justifiable reason for proper care for females, but still could be a blessing in disguise.

Visual acuity recording in children is a very tedious job, especially for the younger children. We encountered similar situation in the younger children which is indicated by the fact that 20 children in our study had a vision of fixation of light and even after the surgery the improvement could not be assessed properly in 6 of the cases. In the cases in which visual acuity could be assessed, the hydrophobic group had 50(90%) cases which had a BCVA better than 6/60 and 37(67%) of them being in the group in 6/6-6/18. On the other hand PMMA group had 30(54%) cases who had BCVA better than 6/60 and only 20(36%) of them achieved a BCVA in the 6/6-6/18 group. Similar results were seen in study conducted by Panahi-Bazaz MR et al 7 who observed 18 (90%) eyes in the acrylic group had BCVA better than 20/200, of which 16 (80%) had BCVA better than 20/60. Corresponding values in the PMMA group were 17 (85%) and 16 (80%), respectively.

The mean cylindrical error was calculated in our study due to the concern of a greater cylindrical error in the patients undergoing SICS due to the bigger wound construction. It was observed in this study that the mean cylindrical error in hydrophobic group was 1.08 ± 0.65 D and in the PMMA group was 1.39 ± 0.56 D. In similar studies by Panahi-Bazaz MR et al 7 the corresponding figures for cylindrical error were 1.03 ± 0.84 in hydrophobic group and 1.58 ± 1.10 D in the PMMA group. The cylindrical error in the hydrophobic group is significantly lesser as compared to the PMMA group.

Hydrophilic acrylic IOLs being composed of a hydroxyethylmethacrylate (poly-HEMA) backbone and hydrophilic acrylic monomers are soft and have excellent biocompatibility because of their hydrophilic surface and 18%–38% water content. These IOLs show little or no surface alterations or damage from folding because of their soft flexible surface.⁹ Low surface energy and hydrophilic nature are major reasons for good uveal biocompatibility. They also have low potential to cause damage when touching corneal endothelial cells. Hydrogel IOLs seem to have lower capsular biocompatibility as compared to other biomaterials, resulting in more LEC outgrowth, anterior capsule contracture and PCO formation following adult

cataract surgery.¹⁰ Also due to a greater inflammatory response, the risk of postoperative complications in pediatric cataract surgery is higher than adults. Visual axis opacification (VAO) is virtually inevitable and rapidly develops following surgery when the posterior capsule is left intact,¹¹ VAO requiring secondary intervention is the most common complication of pediatric cataract surgery with IOL implantation. Despite performing primary posterior capsulotomy and vitrectomy, a second procedure was required in as many as 80% of eyes operated in the first 6 months of life.^{11,12} In our study the incidence of complications were negligible till the follow up period of 6 months. Only 1 case in the hydrophobic group had corneal edema and in the PMMA group 2 cases had VAO and 2 cases had optic capture. The incidence of iris capture following pediatric cataract surgery has been reported 8.5% by Basti et al¹³ and 33% by Vasavada and Chouhan¹⁴ attributing it to the younger age < 2 years and when the IOL optic is smaller than 6 mm and it is implanted in the ciliary sulcus. In our study only 2 cases had optic capture in the PMMA group. In our series, none of the eyes developed IOP rise, glaucomatous changes in the optic disc, clinical cystoid macular edema, retinal detachment or endophthalmitis. The decreased incidence of complications in our series was due to posterior capsulotomy and anterior vitrectomy which were done in all the cases in our series. Also all the cases were done by an experienced paediatric cataract surgeon which reduced complications. The decreased incidence of VAO can also be attributed to the decreased follow up period which was 6 months in our study.

CONCLUSION

Paediatric cataract surgery results in a good visual outcome if surgery is conducted on time and proper refractive and amblyopia therapy is done. Late presentation of patients is a concern which can be handled by spreading awareness among people and organization of camps in places without proper surgical care. Proper evaluation of visual acuity is of foremost importance in assessment of children with cataracts. Our study suggests that hydrophobic lens has better postoperative visual acuity and lesser cylindrical error as compared to PMMA lens.

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