Ophthalmic manifestations in children with delayed milestones

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Aim: The aim of the study is to identify ophthalmic manifestations in children with delayed milestones. Materials and Methods: This was a prospective, observational, and interventional study carried out at tertiary care hospital during July 2016–June 2018 where preschool children with a history of delayed milestones were included. Results: A total of 50 preschool children were included. Male patients (33 [66%]) showed higher incidence than females (17 [34%]). Age group 0–1 year had maximum 17 (34%) cases, followed by 13 (26%) in 1.1–2 years, 6 (12%) in 2.1–3 years, and 7 (14%) each in 3.1–4 years and in 4.1–5 years. Most common ocular manifestations found were congenital cataract 10 (20%), followed by refractive error 8 (16%), 5 (10%) each for optic atrophy and retinal detachment, 4 (8%) strabismus, 3 (6%) nystagmus, 2 (4%) glaucoma, and 1 (2%) each for propotis, disc hypoplasia, microcornea, Persistent Hyperplastic Primary Vitreous (PHPV), iridocorneal endothelial syndrome, and cone dystrophy. Twenty (40%) patients needed no intervention, while glasses were given to 14 (28%) patients, 10 (20%) underwent cataract surgery and 3 (6%) retinal detachment surgery, 2 (4%) patients started on topical medication, and 1 (2%) underwent trabeculectomy surgery. Refractive error found in 8 (16%) children. Twenty-one (42%) patients were associated with various systemic diseases. Along with their primary ocular diseases, five (10%) patients had association with other ocular findings. Conclusion: Children showed improvement in their behavior posttreatment. Parents noticed attentiveness and environmental awareness of children in the surroundings. Children became more responsive in parent–child playful games using colorful objects.

Key words: Delayed milestones, ocular manifestation, preschool children

Vision plays an important role in the acquisition of skills such as language, interpreting facial expressions, and skills requiring hand–eye coordination. If a child continues to have an uncorrected distance visual deficit beyond the age of 10–12 years, the plasticity of the visual system lost, and recovery of vision can be limited. Without sufficient vision, children are limited in every situation, and untreated vision disorders affect their ability to make informed choices and learn from the environment.

Children with disabilities (other than visual impairment) are at higher risk of visual impairment as compared to normal population. Majority of the ocular disorders, such as refractive errors and strabismus, are easily treatable. As these children depend on their visual inputs for social and academic activities, early detection and prompt treatment of even a minor visual problem are of utmost importance for them.

Visual impairment occurs when any part of the optical system is defective, diseased, or malfunctions. Visual disorders are particularly increased in children born preterm, children who have suffered brain-damaging events with resultant learning difficulty and/or cerebral palsy (CP), and children who have congenital cerebral anomalies or other genetic syndromes that may predispose to ocular anomalies.

A visual assessment can be challenging in this group of children and a practical approach to assessment will be outlined. Ocular milestones like fixation develop in the 1st month and completed by 6 months. Fusional reflexes, stereopsis, and accommodation are well developed by 4–6 months. Many ocular diseases have their origin in childhood and the morbidity may go unnoticed and may also cause severe ocular disability in later part of life. As vision is the most important sense for general development and education. The earlier and better the visual sense function, the greater the chance the child has achieved his potential.

The aim of the study was to identify ophthalmic manifestations in children with delayed milestones.

Materials and Methods

This was prospective, observational, and interventional study carried out from July 2016 to June 2018. All pediatric patients with age group up to 5 years of either sex with history of delayed milestones attended in ophthalmic, pediatric, or psychiatric outpatient departments (OPDs) after parents’ consent were included in the study.

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The study was conducted after approval from the Institutional Ethics Committee, and data were collected after written consent of parents.

In OPD, as a routine, detailed ocular examination was done including best-corrected visual acuity measured for both distance and nearby using Snellen’s Chart, Landolt’s “C” chart, Illiterate E cutout test, pictorial vision charts [Figure 1], and LEA Chart (Dr Lea Hyvarinen Chart) [Figure 2]. For infants, preferential looking test [Figure 3] has been carried out. Routine ocular external examination was done with diffuse illumination with a torchlight. Other examinations such as head posture, facial anomalies, ocular motility, dilated fundus examination, cycloplegic refraction, and slit-lamp examination were carried out for each patient. Orthoptic examination was performed using Hirschberg’s reflex test and if required cover/uncover test has been done.

Patients who needed higher investigations such as visual evoked potential, electroencephalography, magnetic resonance imaging, and computed tomography were carried out at the same institute. Patients who had pathology such as cataract, squint or any other ocular deformity was advised investigations for anesthetic fitness for surgery. All patients treated on OPD basis with regular follow-up of 6 months and those who needed hospitalization was admitted in ward and treated accordingly.

**Results**

A total of 50 children with delayed milestones aged below 5 years, who have attended an ophthalmic, pediatric, and psychiatric OPD’s at tertiary care hospital were enrolled in the study. For determining age-wise distribution, five classes of intervals were created. Out of total 50 patients, 17 (34%) were in 0–1 years age group, 13 (26%) in 1.1–2 years, 6 (12%) in 2.1–3 years, 7 (14%) in 3.1–4 years, and 7 (14%) in 4.1–5 years age group.

Demographically, our study showed 33 (66%) males and 17 (34%) females. The various types of ocular abnormalities detected in this study [Table 1]. Out of these, the highest incidence was of congenital cataract found in 10 (20%) patients, followed by refractive error 8 (16%), 7 (14%) patients did not have any abnormality, 5 (10%) optic atrophy, 5 (10%) retinal detachment (RD), 4 (8%) strabismus, 3 (6%) nystagmus, 2 (4%) glaucoma, and 1 (2%) each for proptosis, disc hypoplasia, microcornea, Persistent Hyperplastic Primary Vitreous (PHPV), cone dystrophy, and iridocorneal endothelial (ICE) syndrome.

Out of 50 patients, 20 (40%) patients did not need any active management. All patients were called for regular ophthalmic checkup. After refraction, 14 (28%) patients needed glasses, 10 (20%) underwent cataract surgery, 3 (6%) underwent RD surgery, 2 (4%) patients started on topical medication for glaucoma, and 1 (2%) underwent trabeculectomy surgery [Table 2].

Out of 10 cataract patients, 6 (12%) were operated for both eyes and 4 (8%) for one eye. Five patients kept aphakic, and in five patients, posterior chamber intraocular lens (PCIOL) implantation was done. RD surgery was done for one eye in 3 (6%) patients and trabeculectomy surgery for one eye in 1 (2%) patient. All operated patients were visited for follow-up after 1st, 3rd, and 5th-week, respectively. After 5th week, refraction was done, and accordingly, refractive glasses were prescribed.

A total of 8 (16%) patients had refractive error. Out of these, 4 (8%) patients had hypermetropia, 3 (6%) had astigmatism, and 1 (2%) patient had myopia. Among 50 patients, 42 (84%) patients turned up for regular follow-up of 6 monthly, whereas 8 (16%) failed to follow-up. All patients operated for various surgeries came for follow-up on 1st-, 3rd-, and 5th-week, respectively, thereafter every 6 months. All operated and refractive error patient’s to whom glasses provided, reported

![Figure 1: Picture chart](image1.png)

![Figure 2: (a and b) LEA symbols chart](image2.png)
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by parents to have improved in their social smile, become more active, can recognize mother’s face, and holding and reaching toys or objects. Out of these 50 patients, 21 (42%) were associated with various systemic diseases. CP found in 6 patients, 5 had seizure disorder, 2 had hydrocephalus, 1 each for thalassemia, meningomyelocele, rickets, tuberous sclerosis, mucopolysaccharidosis, Post TORCH infection sequel, intracranial cyst, and congenital myopathy [Table 3].

History of consanguinity was present in eight cases, constituting 16%. Five patients have association with other ocular findings along with their primary ocular disease [Table 4]. Visual acuity of these children categorized into five categories. Those who follows flashlight, not follows flashlight, finger counting close face (FCCF)-finger counting (FC) 6 m, 6/60-6/24, and 6/18-6/6. Out of 50 patients, 31 patients had followed torchlight with central-steady-maintain (CSM) status. Fourteen patients did not or poorly follow torchlight without CSM. One patient had FCCF-FC 6 m vision, 3 had 6/60-6/24, and 1 had 6/18-6/6 [Table 5]. Those ten patients who underwent cataract surgery had improvement in visual acuity after surgery. Those kept aphakic were given aphakic glasses and other had given refractive glasses [Table 6]. Nine (18%) children had history of perinatal and antenatal insult. Out of these, 3 had birth asphyxia, 2 had poor cry after birth, and 1 each had history of torch infection, rubella/cytomegalovirus (CMV)

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**Table 1: Age-wise distribution of ocular diseases**

| Ocular disorders | 0-1 year | 1.1-2 years | 2.1-3 years | 3.1-4 years | 4.1-5 years | Total patients |
|------------------|----------|-------------|-------------|-------------|-------------|----------------|
| Ref error        | 2        | 0           | 3           | 1           | 0           | 8              |
| Strabismus       | 0        | 0           | 1           | 0           | 0           | 4              |
| Nystagmus        | 2        | 0           | 0           | 1           | 0           | 3              |
| Cataract         | 3        | 2           | 1           | 2           | 0           | 10             |
| Glaucoma         | 0        | 0           | 0           | 0           | 0           | 0              |
| Proptosis        | 0        | 0           | 0           | 1           | 0           | 1              |
| Optic atrophy    | 1        | 0           | 0           | 1           | 0           | 2              |
| Disc hypoplasia  | 0        | 1           | 0           | 0           | 0           | 1              |
| Microcornean     | 0        | 0           | 1           | 0           | 0           | 1              |
| RD               | 1        | 0           | 0           | 0           | 0           | 1              |
| PHPV             | 0        | 0           | 0           | 1           | 0           | 1              |
| Cone dystrophy   | 0        | 0           | 0           | 0           | 0           | 0              |
| IEC syndrome     | 1        | 0           | 0           | 0           | 0           | 1              |
| WNL              | 2        | 2           | 0           | 1           | 1           | 7              |
| **Total**        | 12       | 5           | 6           | 7           | 6           | 32             |

**Table 2: Age-wise distribution of treatment offered**

| Treatment       | 0-1 year | 1.1-2 years | 2.1-3 years | 3.1-4 years | 4.1-5 years | Total patients |
|-----------------|----------|-------------|-------------|-------------|-------------|----------------|
| CAT SX          | 3        | 2           | 0           | 3           | 2           | 10             |
| RD SX           | 0        | 0           | 0           | 0           | 2           | 3              |
| TRAB SX         | 0        | 0           | 0           | 0           | 0           | 1              |
| Glasses         | 3        | 1           | 3           | 1           | 2           | 14             |
| Topical MED     | 1        | 0           | 0           | 0           | 0           | 2              |
| No active M/T   | 5        | 2           | 2           | 4           | 3           | 14             |
| **Total**       | 12       | 5           | 6           | 7           | 6           | 32             |

CAT SX: Cataract surgery, RD SX: Retinal detachment surgery, TRAB SX: Trabeculectomy surgery, MED: Medicine, M/T: Management

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**Figure 3: Preferential looking test**
Another study by Katoch reported 83.6% and Akinci comparable with the studies conducted by Smitha with developmental delay were seen in 86% cases. This is in 3–7 years.

In this study, overall ocular manifestations in children with developmental delay were seen in 86% cases. This is comparable with the studies conducted by Smitha et al., who reported 83.6% and Akinci et al., reported 77% of children. Another study by Katoch et al. found that 68% of children with CP had visual morbidity.

In our study, 18% of children with a known case of perinatal or antenatal insult had some ocular disorder. Gogate et al. found perinatal insult in 46.5% of children. This establishes that a child with a history of a stormy perinatal period was more likely to have ocular and visual health issues. The distribution of the type of ocular disorder varied with the

The most common ocular manifestations noted in our study were congenital cataracts; 10% cases followed by refractive errors and 8% cases which is contradictory to various studies. In Smitha KV et al., and in Bankes study, it was refractive errors (59.7% and 49% cases, respectively). Mets study found bilateral optic atrophy to be the most common cause of visual loss (65% cases). Other ocular findings in our study show that 14% patients did not have any ocular abnormality, 10% each in optic atrophy and RD, 8% strabismus, 6% nystagmus, 4% glaucoma, and 2% each for proptosis, disc hypoplasia, microcornea, PHPV, cone dystrophy, and ICE syndrome.

As the study institute is a tertiary center for ophthalmology, various patients were referred here for expert management from various institutes and the remote area of the state. This may be cause for the various differences in ocular findings like cataract (20%) is more common in our study. Other study shows very less cases of RD, whereas in our study, it was found in 10% cases. Furthermore, other studies did not find various other ocular manifestations, while in our study, we found kids with 4% glaucoma, and 2% each for proptosis, disc hypoplasia, microcornea, PHPV, cone dystrophy, and ICE syndrome.

In our study, 16% kids have refractive errors, and among them, majority having hypermetropia (8%) compared to myopia (2%) and astigmatism (6%). Smitha KV et al. also found hypermetropia in 30.04% cases and myopia and astigmatism in 10.86% cases each.

In our study, 16% kids have refractive errors, and among them, majority having hypermetropia (8%) compared to myopia (2%) and astigmatism (6%). Smitha KV et al. also found hypermetropia in 30.04% cases and myopia and astigmatism in 10.86% cases each.

History of consanguinity in our study was present in eight cases, constituting 16%. Whereas in Smitha KV et al. study, it was present in 12 cases constituting 13.04%.

Discussion

This study reiterated certain known facts and unearthed certain new findings during its conduct over the scheduled tenure of 2 years. In our study, male children were more than females. Smitha et al. reported 70.6% males and 49.3% females in Tu and Tsai found 68% males and 32% females. These findings are similar to our study where male patients are more than females. Very few studies are available for ocular manifestations under 5 years of age group. Our study found maximum patients in 0–1 year age group and least in 2 years; Smitha et al. found 28.63% in age group 6 months–1 year, 35.8% in 1–3 years, and 27.1% in 3–7 years.

In this study, overall ocular manifestations in children with developmental delay were seen in 86% cases. This is comparable with the studies conducted by Smitha et al., who reported 83.6% and Akinci et al. reported 77% of children. Another study by Katoch et al. found that 68% of children with CP had visual morbidity.

**Table 3: Ocular diseases associated with systemic illness**

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|---------------------------------------------------------|
| Systemic diseases                                      | 0-1 year | 1.1-2 years | 2.1-3 years | 3.1-4 years | 4.1-5 years | Total     |
|                                                        | Male     | Female     | Male     | Female     | Male     | Female     | Male     | Female     | Male     | Female     | Male     | Female     | Total patients |
| Seizure disorder                                      | 1        | 1          | 0        | 1          | 1        | 0          | 1        | 0          | 0        | 3          | 2          | 5          |
| Cerebral palsy                                        | 1        | 1          | 0        | 1          | 2        | 0          | 0        | 0          | 0        | 1          | 3          | 6          |
| Thalassemia                                           | 0        | 0          | 0        | 0          | 0        | 0          | 0        | 0          | 1        | 0          | 1          | 1          |
| Meningomyelocele                                      | 0        | 0          | 0        | 0          | 0        | 0          | 0        | 0          | 1        | 0          | 1          | 1          |
| Rickets                                               | 1        | 0          | 0        | 0          | 0        | 0          | 0        | 0          | 0        | 1          | 0          | 1          |
| Intracranial cyst                                     | 1        | 0          | 0        | 0          | 0        | 0          | 0        | 0          | 0        | 1          | 0          | 1          |
| Tuberous sclerosis                                    | 0        | 0          | 0        | 0          | 0        | 0          | 1        | 0          | 0        | 0          | 1          | 0          |
| Post-TORCH sequelae                                   | 1        | 0          | 0        | 0          | 0        | 0          | 0        | 0          | 0        | 1          | 0          | 1          |
| Myopathy                                              | 0        | 0          | 1        | 0          | 0        | 0          | 0        | 0          | 0        | 1          | 0          | 1          |
| Hydrocephalus                                          | 0        | 0          | 0        | 0          | 0        | 0          | 0        | 0          | 1        | 0          | 2          | 0          |
| Mucopolysaccharides                                   | 0        | 0          | 0        | 0          | 0        | 0          | 0        | 0          | 1        | 0          | 1          | 1          |
| No systemic association                               | 7        | 3          | 4        | 5          | 3        | 0          | 3        | 1          | 1        | 2          | 18         | 11         |
| Total                                                  | 33       | 17         | 20       | 19         | 13       | 10         | 17       | 10         | 19       | 33         | 20         | 13         |

**Table 4: Primary ocular disorder and associated ocular findings**

| Table 4: Primary ocular disorder and associated ocular findings |
|---------------------------------------------------------------|
| Age       | Sex | Primary diagnosis | Associated ocular findings |
|-----------|-----|-------------------|---------------------------|
| 3 years   | Male| Proptosis          | Nystagmus                 |
| 4 years   | Female| Retinal detachment | Micro-cornea               |
| 2 years   | Female| Congenital cataract | Buphthalmos + aniridia    |
| 3 months  | Male| IEC syndrome       | Megalocornea               |
| 2 years   | Male| Congenital cataract | Nystagmus                  |

IEC: Iridocorneal endothelial
type of perinatal insult suffered. Out of these, 6% had birth asphyxia, 4% had poor cry after birth, and 2% each with h/o TORCH infection, rubella and CMV infection, fever with medication, and TB during ANC.

Twenty-one (42%) kids in our study were associated with various systemic diseases. CP found in 6 (12%) kids, 5 (10%) had seizure disorder, 2 (4%) had hydrocephalus, 1 (2%) each for thalassemia, meningomyelocele, rickets, tuberous sclerosis, mucopolysaccharide, post-TORCH sequelae, intracranial cyst, and congenital myopathy. Twenty-nine (52%) patients did not have any systemic illnesses. Gogate et al. found 3.76% patients with CP and 11.14% with seizure disorder.

Along with the primary ocular disorder, 10% (5 cases) patients have association with other ocular findings [Table 4].

Out of 10 cataract patients, 6 were operated for both eyes and 4 for one eye. Five patients kept aphakic, and in five patients, PCIOL implantation was done. Those ten patients who underwent cataract surgery had improvement in visual acuity after surgery. Those kept aphakic had given aphakic glasses and other given refractive glasses [Table 6].

Visual impairment is known to delay and alter both visual and general development. Undetected visual impairment combined with other handicaps is likely to have an adverse effect on development and may lead to an underestimation of intellectual ability. Visual function can be improved by the provision of spectacles and/or visual training to improve fixation and accommodation, social behavior, and motor skills of children at all levels of intellectual impairment have shown improvement.

These children after getting good ophthalmologic treatment showed improvement in their delayed milestones [Table 7]. Parents noticed improvement in child’s social activity, social smile, play with toys, reach objects, hand–eye coordination, etc., Although our study was conducted in small population in limited period, it showed that early ophthalmologic management in delayed milestones and mentally disabled children can lead to further improvement in their mental status. Very few such studies are conducted in this age group. This study may help to carry out such more studies.

### Table 5: Age-wise distribution of visual acuity

| Visual acuity | 0-1 year | 1.1-2 years | 2.1-3 years | 3.1-4 years | 4.1-5 years | Total |
|---------------|----------|-------------|-------------|-------------|-------------|-------|
|               | Male     | Female      | Male        | Female      | Male        | Female |
| Fixating      | 9        | 2           | 6           | 5           | 4           | 0     | 2     | 0     | 2     | 1     | 23    | 8     | 31    |
| Nonfixating   | 3        | 3           | 0           | 2           | 1           | 0     | 1     | 2     | 1     | 1     | 6     | 8     | 14    |
| FCCF-FC6MT    | 0        | 0           | 0           | 0           | 0           | 0     | 0     | 0     | 0     | 1     | 0     | 1     | 1     |
| 6/60-6/24     | 0        | 0           | 0           | 0           | 2           | 0     | 0     | 1     | 0     | 0     | 1     | 1     | 3     |
| 6/18-6/6      | 0        | 0           | 0           | 0           | 1           | 0     | 0     | 0     | 0     | 0     | 1     | 0     | 1     |
| Total         | 12       | 5           | 6           | 7           | 6           | 0     | 5     | 2     | 3     | 4     | 32    | 18    | 50    |

FCCF: Finger counting close to face, FC: Finger counting, MT: Meter

### Table 6: Visual acuity after cataract surgery

| Age          | Sex | B/L or U/L CAT SX | VA before SX | VA after SX |
|--------------|-----|-------------------|--------------|-------------|
|              |     |                   | RE           | LE          | RE          | LE          |
| 2 months     | Female | RE                | Not follows light | Follows light | Follows light | Follows light |
| 3 years      | Male    | BE                | Follows light | Follows light | Follows light | Follows light |
| 3 years      | Male    | RE                | Not follows light | Not follows light | Follows light | Follows light |
| 2 years      | Female  | BE                | Follows light | Follows light | Follows light | Follows light |
| 8 months     | Male    | BE                | Follows light | Follows light | Follows light | Follows light |
| 10 months    | Male    | RE                | Follows light | Follows light | Follows light | Follows light |
| 2 years      | Female  | BE                | Follows light | Follows light | Follows light | Follows light |
| 2 years      | Male    | BE                | Follows light | Follows light | Follows light | Follows light |
| 9 months     | Female  | RE                | Follows light | Follows light | Follows light | Follows light |
| 1 month      | Male    | BE                | Follows light | Follows light | Follows light | Follows light |

B/L: Bilateral, U/L: Unilateral, SX - Surgery, CAT SX: Cataract surgery, VA: Visual acuity, RE: Right eye, LE: Left eye
challenged children helps in stimulating the important sense of vision which helps in developing visual abilities and efficacy most suited to their needs and enables those individuals to achieve maximal level of visual performance. It further helps in overall social and mental development of these children by effectively treating physiological neuromuscular and perceptual dysfunction of visual system.

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**Conflicts of interest**
There are no conflicts of interest.

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**Table 7: Pre- and post-treatment analysis**

| Serial number | Age   | VA            | Diagnosis              | Systemic association | Treatment given | Observed delayed milestones | Pretreatment VA | Posttreatment VA | Improvement in delayed milestones               |
|---------------|-------|---------------|------------------------|----------------------|-----------------|----------------------------|----------------|------------------|-----------------------------------------------|
| 1             | 2 months | RE poor fixation | RE CAT               | No                   | RE CAT SX       | Poor eye contact Poor hand-eye coordination | BE fixating light | Good eye contact Improved hand-eye coordination |
| 2             | 3 years  | BE not fixating | RE CAT               | History of seizure disorder | RE CAT SX       | Not draws circles, not holding pencil | BE fixating | Tries to hold pencil and draw circle             |
| 3             | 1.5 years | BE follows light | BE Ref error         | History of seizure disorder | Glasses         | Not recognize familiar picture Not scribbles on paper | BE follows torchlight | Recognize familiar picture Scribbles on paper Feeding self with hands |
| 4             | 10 months | RE not fixating | RE CAT               | No                   | RE CAT SX       | Not using both hands to play toys Poor social smile | BE fixating | Using both hands to play toys Improved social smile |
| 5             | 5 years  | BE follows light | BE Ref error         | Cerebral palsy       | Glasses         | Not dresses alone Not plays with other children | BE 6/60  | Dresses alone Try to play with other children |
| 6             | 7.1 months | BE poorly states | BE Ref error         | Seizure disorder     | Glasses         | Not reaches for object Not plays with toys | BE follows light | Reaches objects Plays with toys in front of face |
| 7             | 10 months | BE follows light | BE cataract           | No                   | BE CAT SX       | Not grasping objects | BE fixating | Grasping objects |