

Current Causes and Ocular Abnormalities in Children with Cerebral Palsy

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DOI: <https://doi.org/10.51244/IJRSI.2025.121500019P>

Received: 02 February 2024; Accepted: 07 February 2025; Published: 08 March 2025

ABSTRACT

Purpose: To determine the causes and spectrum of ocular abnormalities in children with Cerebral palsy (CP).

Methods: A total of 80 children with cerebral palsy attending in Chittagong Eye Infirmary & Training Complex underwent a comprehensive ophthalmic and optometric examination. The examinations were consisting of assessment of visual acuity, extra ocular motility, binocular single vision, accommodative status, anterior and posterior segment evaluation; Cycloplegic refraction and funduscopy were performed in all cases.

Results: A total 80 children aged between 06 months to 10 years (mean 2.31 ± 2.18 years) with CP were included in the study, 67.5% were males and 32.5% were females. Majority of cases were spastic CP 43(53.8%). Intranasal assault (47.29%) comprises the major causes of CP. Ocular abnormalities were noticed in 94.7% of the children. The major ocular abnormalities were refractive errors 70 (87.7%) and strabismus 34 (42.5%).

Conclusion: Birth asphyxia due to prolonged labor causing convulsion is the main causes of CP. Ocular abnormalities are common among CP children. Early identification of treatable ocular defects and their treatment along conventional lines is emphasized. A full eye examination should be sought as soon as a diagnosis of CP is made and yearly thereafter.

Key Words: Cerebral palsy, spastic, Birth asphyxia, Refractive Error

INTRODUCTION

Cerebral palsy (CP) describes a group of disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain¹. Prevalence of cerebral palsy (CP) is 3.4 per 1000 children in Bangladesh². The motor abnormalities dominate the clinical picture and form the basis for the definition of cerebral palsy^{3,4}. The majority of motor disorders are spastic, Athetoid, ataxic and mixed in that order of frequency, and the topography relates to the description of the limb or limbs involved-for example, monoplegia, diplegia, hemiplegia, tetraplegia, and quadriplegia.⁴ The damage to the developing brain can occur during pregnancy,

Intranasal or post-natal life. While the motor abnormalities are the most apparent clinically, there are commonly associated varying degrees of mental sub normality, emotional instability, and convulsive disorders.¹ In addition sensory abnormalities, particularly deafness and visual disability are common. It was also noted the risk of certain groups of children having their visual disabilities ignored or overlooked. Visual function is related to cognitive, motor and emotional development since children learn to move, talk and do many things they see others doing. Children with cerebral palsy associated with visual impairment possess a greater challenge in terms of management and rehabilitation. Early detection and treatment of ocular problems will therefore enhance management in this group of children. This study explores and documents the variety of ocular problems in children with CP and educates the parents of these children concerning the importance of eye and vision examinations. It is also help to promote earlier examination of CP children so that quality of life (QOL) in these children may be improved.

METHODS

It was cross-sectional hospital-based study. It was conducted at pediatric outpatient department and low vision department in Chittagong Eye Infirmary & Training Complex. All the patient was diagnosed as cerebral palsy (CP) from different hospitals. The study period was 1year (1st January 2024 to 31th December 2024). Informed consent was taken from parents or legal guardians. A brief history of the visual behavior of the child, along with histories of antenatal, Intranatal, postnatal and other maternal factors were taken.

Presenting visual acuity was assessed monocularly. Depending upon the age and cooperation of the patients, a variety of methods were used for assessing visual acuity such as following objects, CSM (central, steady & maintenance) methods, Preferential looking test (Cardiff acuity test) and Kay picture test. Ocular motility was evaluated by moving a highly interesting colorful object or low intensity red light in six different cardinal gazes and Dolls eye test was performed in non-cooperative children. Hirschberg test, Bruckner's test and cover test were done to detect the strabismus. These were done only for nearby. Mahindra near retinoscopy was done to find out the gross refractive status followed by cycloplegic refraction. The standards for quantifying refractive error were as follows: myopia was considered to be a mean spherical equivalent of $\geq -1.00D$; hyperopia $\geq +1.00D$; astigmatism as $\geq \pm 1.00D$ in any meridian and anisometropia as (mean sphere) $\geq 1.00D$.

Detailed examination of the anterior segment was carried out with a standard slit lamp bio microscope. The posterior segment evaluation in every patient was carried out in a fully dilated state of the eyes with indirect ophthalmoscope.

These study data were all compiled into an Excel file created with Microsoft Office 2010. Then, IBM® SPSS® Statistic 16 was used to perform the analysis. For continuous variables Descriptive statistical measures such as mean \pm Standard Deviation (SD) and for categorical variables percentages were computed. Chi square was used to compare the outcome variables or association between two independent categorical variables. A value of $P < 0.05$ at 5% level of significance was defined as statistically significant.

RESULTS

Demographic information: A total of 80 children with CP were included in the study. Among them 67.5% were males and 32.5% females with a male to female ratio of 2:1. The mean age of the children was 2.31 ± 2.18 years (Range: 06 months to 10 years). About 57 (71.2%) participants were brought from different rural area and 23(28.8%) from urban area.

Types and causes of CP: In case of clinical types of CP, spastic CP accounted for 43(53.8%) cases. (Table 1)

Table 1: Types of Cerebral palsy

Type of CP	Frequency	Percentage
Spastic	43	53.8
Athetoid	20	25.0

Mixed	10	12.5
Ataxic	07	8.8
Total	80	100.0

In our study, 8(10%) children were premature and low birth weight i.e. ≤ 2.5 kg found in 20 (25%) cases. both groups were screened for retinopathy of prematurity (ROP). Parents of 11 (13.75%) children had some form of consanguineous relationship. Among 80 Children with CP most of the children were the 1st issue of their parents and the number was 50(62.5%). (Table 2)

Table 2: Issue of the parents

Issue	Frequency	Percentage
1st	50	62.5
2nd	17	21.2
3rd	12	15.0
4th	1	1.2
Total	80	100.0

Most of the children with CP were delivered after prolonged labor and after Caesarean section when every attempts of normal delivery were in vain causing foetal distress. (Table 3)

Table 3: Types of delivery

Types of delivery	Frequency	Percentage
Normal(home delivery)	55	68.8
normal(hospital)	9	11.2
Caesarean Section	16	20.0
Total	80	100.0

The causes of CP were categorized into 3 types such as antenatal, intranatal and postnatal. The majority cases were found in intranatal (47.29%) followed by postnatal (36.36%), antenatal problem (16.35%). In Intranatal groups, highest percentage were in prolong stage of labor (38.18%). (Table 4)

Table 4: Causes of CP

	Factors	Percentage
Antenatal (16.35%)	Maternal Infection (Rubella, UTI, Jaundice, Typhoid, Diarrhea, Chikungunya, TB)	9.67
	Maternal Systemic Disease (DM, HTN, Hypotension, Asthma, Hypothyroid)	6.66
	H/O trauma	1.81
	Eclampsia	1.21
	Intranatal (47.29%)	Prolong stage of labor/Obstructive labor
	Birth trauma	4.25
	Breach baby	2.42
	Twin pregnancy	1.82
	Oligohydramnios	0.62
	Convulsion	18.18
	Pneumonia	9.08

Postnatal (36.36%)	Jaundice	5.45
	Infection (encephalitis, meningitidis)	1.82
	Neonatal hypoglycemia	1.21
	Anemia	0.62
Total		100

Ocular Findings: About 77.5% of the children had not had any previous eye examination. Ocular abnormalities were detected in 94.7% of the children. Multiple ocular abnormalities were present in 51.25% of the children. Overall co-morbidity findings of 80 children with CP are summarized in Figure 1.

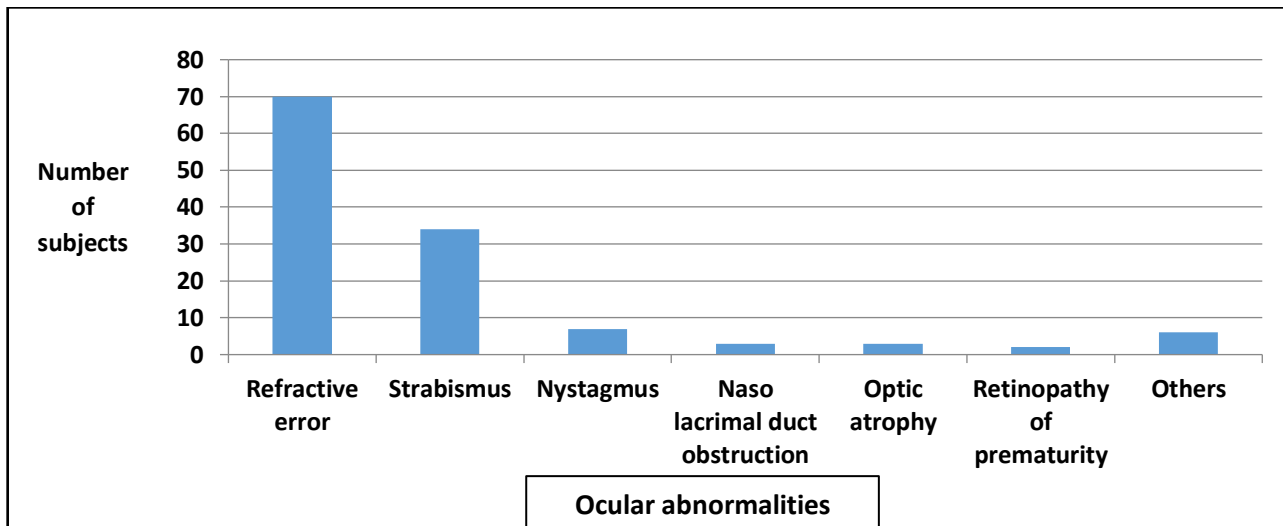


Figure 01: Ocular abnormalities in 80 children with CP

***Other ocular findings associated with CP were ptosis, cataract, pathological Myopia, physiological cupping, double elevator palsy and macular dystrophy.

Visual Acuity: Visual acuity was assessed in all the children. In our assessment, 45.8% were non responsive and the rest are responsive. Among them, the most frequently used method was the CSM technique, which was used for 46.8% of the children followed by the Kay picture test (7.4%). The percentage of children and the tests that were used for them is depicted in Table 5.

Table 5: Vision assessment (CSM method, KPT) in children with CP

	Frequency	Percentage
CSM +ve	47	29.2
CSM -ve	28	17.6
6/6	1	0.6
6/9-6/18	5	3.1
6/24-6/60	5	3.1
<3/60	1	0.6
Non responsive	73	45.8
Total	160(n=80)	100

*Eyes were counted separately as right eye and left eye for categorization

Refractive status: Refractive error as defined by the parameters of this study was present in 87.7% of the children. Findings reveal that, 2.8% of the children had myopia, 13.4% hyperopia, and 79.6% had astigmatism, either in isolation or compounded with myopia or hyperopia. 2.8% of the children had anisometropia and 1.4% Antimetropia. (Table 6)

Table 6: Percentage distribution of refractive error

Types of Refractive Error	Percentage (%)
Myopia	2.80%
Hyperopia	13.40%
Myopic astigmatism	31%
Hyperopic astigmatism	35.90%
Mixed astigmatism	12.70%
Anisometropia	2.80%
Antimetropia	1.40%
Total	100%

Binocular vision status: Binocular vision status was assessed using various tests according to the cooperation of children and viability for the examiner. The findings were as follows (Table 07)

Table 07: Binocular vision status in children with CP

Contents	Frequency	Percentage
Orthoptic status		
Orthophoria	46	57.5
Exotropia	18	22.5
Esotropia	14	17.5
Hypertropia	2	2.4
Extra ocular motility:		
Full	78	97.6
Limitation(in adduction)	2	2.4

Refractive error and strabismus according to types of CP: Esotropia was seen more in spastic group (23.25%), Exotropia in athetoid (35%) and in mixed (30%) CP type. In refractive error, the majority percentages were myopic astigmatism in spastic group (29.07%), hyperopic astigmatism in athetoid group (40%) and mixed astigmatism in ataxic group (42.86%).(Table 8)

Table 8: Refractive error and Strabismus according to Types of Cerebral Palsy

Strabismus	Spastic (n=43)	Athetoid (n=20)	Ataxic (n=7)	Mixed (n=10)	P value
Orthophoria	60.47%	40%	71.42%	70%	X² = 84.875P < 0.001
Esotropia	23.25%	20%	14.29%	—	
Exotropia	16.28%	35%	14.29%	30%	
Vertical deviation	—	5%	—	—	
Total	100%	100%	100%	100%	
Refractive Error	Spastic (n=43)	Athetoid (n=20)	Ataxic (n=7)	Mixed (n=10)	P value
Emmetropia	13.95%	10%	—	10%	X² = 26.250P < 0.001
Myopia	2.33%	5%	—	—	
Hyperopia	12.79%	15%	14.29%	—	
Myopic astigmatism	29.07%	25%	14.29%	35%	

Hyperopic astigmatism	24.41%	40%	28.56%	50%	
Mixed astigmatism	12.79%	–	42.86%	5%	
Anisometropia	2.33%	5%	–	–	
Antimetropia	2.33%	–	–	–	
Total	100%	100%	100%	100%	

DISCUSSION

Cerebral palsy is commonly associated with ocular abnormalities which often impact on their development and education. Visual processing involves a large part of the central nervous system. For this reason, the types of brain damage that cause cerebral palsy especially hypoxic-ischemic encephalopathy (HIE), Periventricular leukomalacia (PVL), injury to the brain’s white matter, are also result in vision problems.⁶

A total of 80 children with CP were assessed. In this study, a higher prevalence of CP was discovered in boys (67.5%) than girls (32.5%), which is consistent with previous studies^{5, 10, 16-19} and a male to female ratio of 2:1. In another study they also found similar ratio between male to female⁵. The mean age of the children was 2.31±2.18 years (Range: 06 months to 10 years). Maximum were from rural area 57 (71.2%) where the rest were brought from urban area 23 (28.8%). Literature showed that children who are born in rural areas had a higher prevalence of CP, particularly severe CP.^{17,19} Because people living in rural areas are less likely to use medical services, it is important to facilitate the access to relevant health services for children with CP residing in rural areas to help them achieving optimal development and health.

Home delivery is still being practiced in many parts of our country that puts the health of mother and child both at risk. In our study, we found that 55 (68.8%) children were born at home, and maximum deliveries were attended by traditional birth attendant (TBA) and neighbor; few were in hospital through normal delivery 9 (11.2%). Most of the children with CP were delivered after prolonged labor and after Caesarean section when every attempts of normal delivery were in vain causing fetus distress. There is need of total restructuring and strengthening of our antenatal and natal care system to prevent these avoidable risk practices²⁰. Among 80 children with CP most of the children were the first issue of their parents and the number was 50 (62.5%).

Asphyxia due to intranatal assault which is in prolong stage of labor (38.18%) resulting fetus distress and convulsion (18.18%) was the major cause CP in our study. Infections during the antenatal period can injure the developing fetus and frequently associated factors, thereby leading to CP²⁰. However, this study found that maternal infection (rubella, UTI, jaundice, typhoid, diarrhea, chikungunia and TB) was 9.57 % which reflects the literature thoughts. In our study, 8 (10%) children were premature and low birth weight (i.e. ≤ 2.5 kg) found in 20 (25%) cases. Both groups were screened for retinopathy of prematurity (ROP). Consequently, we found retinopathy of prematurity in 2 (2.5%) cases. Other risk factors for the development of CP in this study included meningitis/ encephalitis (1.82%), jaundice (5.45%), pneumonia (9.08%) and neonatal hypoglycemia. The association of consanguinity with complex disorders such as cerebral palsy is new and the results are ambiguous. Out of a total of 80 children with CP, parents of 11 (13.75%) children had some form of consanguineous relationship. Recent study holds in Jordan and Syria which examined global developmental disorders including cerebral palsy found that consanguinity was a major risk factor^{12,13}. As reported by other study, Spastic cerebral palsy was more common than other types of cerebral palsy⁴⁻¹⁰.

A spectrum of visual disorders is prevalent in children with CP and has been described extensively in the literatures. Refractive error and strabismus form by far the largest group of abnormalities^{4, 5,7-11,21-22}. About 77.5% of the children had not had any previous eye examination, which strongly suggests that eye care providers and the parents of children are still unaware of the high incidence of ocular problems in those with CP. Ocular abnormalities were detected in 94.7% of the children and this rate was found to be consistent with other literature. Ocular abnormalities were reported with the range from 50% to 95% in cases with the diagnosis of CP.^{5,7-11,21} The prevalence of ocular abnormalities in children with CP is higher than the general population of school children. This emphasizes the need for a proper ocular examination of all children diagnosed with CP.

Visual acuity was assessed in all the children. In our assessment, 45.8% were non responsive and the rest were responsive. Among them, the most frequently used method was CSM technique, which was used for 46.8% of the children followed by the Kay Picture test (7.4%). A snellen equivalent visual acuity of 6/6 was recorded in 0.6% children, 6/9 to 6/18 in 3.1 % and less than 6/18 in 3.7% cases.

Refractive error was the most common type of abnormality documented in 70 (87.7%) cases. However, prevalence rates of abnormal refractive errors in patients with CP 29% to 79% have been reported in other parts of the world.^{5,7-11,21-22}. This emphasizes the need for appropriate referral and management of refractive problems and counseling of parents on the need for vision care in children with cerebral palsy. We found the incidence of myopia and hyperopia to be considerably larger than that reported in normal children. Fant and Perlstein reported a higher prevalence of myopia in those with spastic CP and found that hypermetropia was more prevalent in CP with dyskinesia (Athetoid)¹⁴. Our study findings weren't consistent with it. In this study, the majority percentages were myopic astigmatism in spastic group (29.07%), hyperopic astigmatism in athetoid group (40%) and mixed astigmatism in ataxic group (42.86%). In our study, 2 children (2.8%) were anisometric, one child was antientropic (1.4%) and one subject with pathological myopia was found. However, early detection and correction of these errors are important as the correction can make a significant difference in the children's ability to see and improved their performance.

The prevalence of strabismus observed in the present study 42.5% (34) resembles well with other parts of the world (India-36.83%, 39%; Japan-33.1%; Africa-50%, Nepal-36%).^{4,5,7-11,15,21-22} Exotropia was seen to occur more frequently in CP patients than in normally developing children. Esotropia was seen more in spastic group (23.25%), Exotropia in athetoid (35%) and in mixed (30%) CP type. Various ranges for the incidence of nystagmus have been reported in CP (1.02% – 18%),^{5,7-11,21} and our study agrees with this range (8.57%).

The prevalence of ptosis 2(2.5%) found in our study agrees with that reported in other studies (1.43%, 1.02%, 2.5%, 3%)^{4,9,10}. Cataract found in one case (1.41%) which also coincides with other studies. We also found agreement with the literature on the prevalence of retinopathy of prematurity (3.75%) and optic atrophy 3(3.75%)^{4,5,8,9,10}

There was a limitation in this study, mainly in facing difficulties in testing patients with CP in particular the tests available to undertake a complete ophthalmological evaluation because of their poor co-operation and psychological behavior. Moreover, children with CP often present a complicated clinical picture that can affect the reliability of the findings obtained through such a complex evaluation.

Birth asphyxia due to prolonged labor causing convulsion is the main cause of cerebral palsy. Appropriate intervention that can improve safe intranatal care is crucial to avoid these unwanted complications. Ocular morbidities are common among children with CP. Refractive error and strabismus was seen in a high percentage of these children. Children with cerebral palsy associated with visual impairment possess a greater challenge in terms of management and rehabilitation. Early detection and multidisciplinary management approach are utmost necessity for better visual development.

ACKNOWLEDGEMENTS

We would like to express our gratitude to all the staffs of Pediatric and Low vision departments of Chittagong Eye infirmary & training complex (CEITC) for their support during data collection. We also thankful to those guardians of children support us to make this study successful.

Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this study.

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