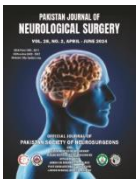

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Original Research

A Study on Ocular Manifestations Seen in Patients with Cerebral Palsy

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ABSTRACT

Background: Cerebral palsy (CP) encompasses various neurological disorders like abnormal brain development or permanent brain damage, impacting muscle tone, and motor function. This study assessed ocular manifestations in patients with CP, including visual acuity, refractive errors, ocular alignment, and anterior and posterior eye segments.

Materials & Methods: This retrospective study was conducted at the Department of Ophthalmology Khyber Teaching Hospital (KTH) from 1st November 2022 to 30th September 2023. Data collected included detailed medical, ocular, and birth histories, age and gender of the patient, type of CP, visual acuity (VA) if possible, type of refractive error, ocular alignment and motility and anterior and posterior segments examination of the eyes. Data analysis was done using SPSS version 23.

Results: The study included 40 patients of which twenty-nine (72.5%) were male. The study found spastic CP to be the most prevalent in 23 (57.5%) patients followed by hypotonic CP 12 (30%) and mixed type 5 (12%). VA was examined in CP patients over 4 years with a mean VA of 0.6 and a range of 0.0 to 0.8 LogMAR. Strabismus was found in 33(82.5%) patients with esotropia being the most common in 21 (52.5%) patients, exotropia in 6 (15.0%) patients, and vertical deviation in 6 (15.0%) patients. Ocular motility defect of abduction deficit was found in 2 (5%) patients. Other findings included ptosis in 1(2.5%), nystagmus in 2(5%).

Conclusion: Most children with cerebral palsy exhibit ocular abnormalities, necessitating regular ophthalmic examinations to prevent life-long visual disabilities/complications and to support their overall development.

Keywords: Cerebral Palsy, Ocular, Ophthalmic, Neurological disorders.

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INTRODUCTION

The term "cerebral" refers to the brain, and "palsy" denotes a lack of muscle control. Cerebral palsy (CP) is a complex and lifelong neurological condition that primarily affects a person's ability to control their muscles and body movements.[1] It is one of the most common physical disabilities in childhood, with an impact that can extend throughout a person's life. This condition results from abnormalities or damage to the developing brain, typically occurring before, during, or shortly after birth.[2] The specific causes of CP can vary, but they all share the commonality of affecting the brain's development. These causes can include factors such as prenatal infections, maternal health issues, genetic factors, or complications during labor and delivery. In some cases, the exact cause remains unknown.[2]

Immature brain defects or lesions cause cerebral palsy, mobility, and postural conditions.[3] Motor anomalies classify cerebral palsy as spastic (four kinds), ataxic, athetoid, or atonic. Significant refractive errors, strabismus, nystagmus, amblyopia, and cortical visual impairment affect 50–90% of cerebral palsy patients.[3] Ocular abnormalities vary by cerebral palsy type. Spastic type has more ocular defects than athetoid or ataxic kinds.[3]

Strabismus is a common cerebral palsy co-morbidity.[4] It is agreed that strabismus is far more common in CP than in the normal, non-CP population (estimated at 2-3%), but reports vary from 15% to over 90%. Strabismus prevalence in CP varies across research, geographies, and races. The sole comprehensive analysis of strabismus in CP6 assessed its frequency at 48%, however, Caucasians in high-income nations were overrepresented and Africans and Asians in low-income countries were underrepresented.[4]

Diagnosis of CP typically occurs in early childhood when the signs of motor impairment become evident. CP manifests in a wide spectrum of symptoms and functional limitations.[5] These may include difficulties with muscle coordination, muscle stiffness (spasticity), muscle weakness, balance problems, and mobility challenges. The severity of these symptoms can range from mild, where an individual may experience only minor difficulties, to severe, where mobility and daily activities are significantly impaired.[2]

It's important to note that CP is a non-progressive condition, meaning the underlying brain damage does not worsen over time. However, the functional limitations and associated health issues can change as a person grows and develops.[6] Therefore, regular systemic and ophthalmic assessments are needed to address the issues in patients with CP. Therefore, we conducted this study to assess the ophthalmic manifestations of patients with CP at presentation to the ophthalmic outpatient department. This study aimed to assess the vision and refractive errors and ocular motility abnormalities along with anterior and posterior segments of eyes in patients with CP.

MATERIALS & METHODS

Study Design, Duration, and Setting

This retrospective study was conducted at MTI-Khyber Teaching Hospital, Peshawar from November 1, 2022, to September 30, 2023. Data was collected from OPD slips of all patients and was entered into Excel sheets.

Ethical Approval

Ethical approval from the Ethical Review Board of Khyber Medical College was obtained for publishing the data.

Sampling Technique and Sample Size

It included 40 diagnosed CP cases referred to by pediatricians/medical specialists/neurophysicians. Informed consent was obtained from parents or guardians.

Data Collection Procedure and Clinical Manifestation

Detailed medical and ocular histories were collected, including birth history, family history, history of developmental milestones, and immunization. Data collected included detailed medical, ocular, and birth histories, age and gender of the patient, type of CP, visual acuity, if possible, type of refractive error, ocular alignment and motility and anterior and posterior segments examination of the eyes. Visual acuity was assessed using Snellen's visual acuity chart and Lea symbols and was converted into LogMAR. Cycloplegic refraction was performed in all cases. Refractive errors were classified as hypermetropia, myopia, and astigmatism. Hypermetropia greater than 4 diopters, myopia greater the 5 diopters, and astigmatism greater than 2 diopters were considered significant.

Ocular alignment was assessed using the Hirschberg test and cover-uncover test. Extraocular motility was evaluated by using a colored light source. Anterior segment examination was performed with the handheld slit lamp. Posterior segment examination including optic disc and macular examination was performed using a binocular indirect ophthalmoscope.

Statistical Analysis

Data analysis was done using SPSS version 23. Frequencies and percentages were extracted for the categorical variables. For association, Fisher's Exact test was used. P-values less than 0.05 were considered significant.

RESULTS

Age, Gender-wise distribution of CP patients, and Types of cerebral palsy.

Twenty-nine (72.5%) patients were male and 11 (27.5%) were female. The mean age was 2.8 years with a minimum age of 6 months and a maximum age of 16 years. The study found spastic cerebral palsy to be the most prevalent. Number of patients with different types of CP is given in Table 1.

Table 1: Types of cerebral palsy.

Types of Cerebral Palsy	Frequency	Percentage
Spastic	23	57.5%
Hypotonic	12	30%
Mixed	5	12%

Association of Age & Visual Acuity

Children were divided into two groups for assessing their VA. It is given in Table 2.

Table 2: Age distribution and percentage.

Age	Number	Percentage
6 months- 4 years	28	70%
4 years- 16 years	12	30%

VA was assessed only in children more than 4 years of age as younger children with CP were not cooperative enough for VA assessment with Snellen's VA chart or with Lea symbols. Lea symbols were used in 8 (20%) children. Snellen's visual acuity was done in 4 (10.0%). For statistical analysis, VA was converted into LogMAR acuity. The mean VA was 0.6 LogMar with a range of 0.0 to 8.0 LogMAR. Visual acuity was checked in 12 (30%) children above 4 years of age. Six (15%) patients have cerebral visual impairment.

Refractive Errors

Thirteen (32.5%) patients have significant refractive errors, out of which hypermetropia was

present in 8 (20%) patients, and myopia in 4 (10%) patients. Astigmatism alone was found in 1 (2.5%) patient.

Ocular Motility/Alignment

Ocular motility and alignment were assessed in all children. On assessing ocular alignment, 33 (82.5%) children were found to have strabismus. Strabismus was more prevalent in children with CP. Esotropia was the most common type of strabismus. The number and percentages of patients with strabismus are given in Table 3.

Table 3: Type of Strabismus.

Type of Strabismus	Number	Percentage
Esotropia	21	52.5
Exotropia	06	15.0
Vertical deviation	06	15.0

Other associated abnormalities included abduction deficit in 2 (5.0%) patients. Bilateral ptosis was found in 1 child (2.5%).

Anterior & Posterior Segments Examination

Anterior segment examination showed bilateral cataracts in 1 (2.5%) patient that was operated on. Fundus examination showed optic nerve head hypoplasia in 1 (2.5%), nystagmus in 2(5%), and optic atrophy in 3 (7.5%). No macular pathology was found in any patient with CP on indirect ophthalmoscope examination.

Association of Ocular Characteristics in Different Types of Cerebral Palsy

Table 4 provides a systematic classification and measurement of visual features in individuals diagnosed with three specific forms of cerebral palsy: Spastic, Hypotonic, and Mixed. The evaluated criteria include refractive errors, ocular motility problems, diseases of the anterior and posterior segments, and visual acuity measures. The categories are further separated into conditions, including emmetropia, myopia, hypermetropia, astigmatism, different forms of strabismus (esotropia, exotropia), and assessments of visual acuity using Lea Symbols and the Snellen chart. Emmetropia was detected in 16 instances (67%) of Spastic cerebral palsy, 8 cases (33%) of Hypotonic cerebral palsy, and 3 cases (13%) of Mixed cerebral palsy. Similarly, the absence of strabismus was seen in 3 instances of Spastic (25%), 1 case of Hypotonic (8%), and 0 cases of Mixed (0%). The table includes P-values, such as 0.222 for refractive error, 0.856 for mobility, and 0.302 for anterior segment conditions. These P-values indicate the statistical non-significance of the differences discovered among these groups. This comprehensive listing and examination aid in comprehending the visual effects of various forms of cerebral palsy and may direct specific therapy and management approaches.

Table 4: Association of Ocular Characteristics in Different Types of Cerebral Palsy.

Parameter	Sub parameters	Type of Cerebral Palsy			P-Value
		Spastic	Hypotonic	Mixed	
Refractive Error	Emmetropia	16	8	3	0.222
	Myopia	2	2	0	
	Hypermetropia	5	2	1	
	Astigmatism	0	0	1	
	No Strabismus	3	1	0	
Mobility	Esotropia	12	7	2	0.856
	Exotropia	4	1	1	

	Vertical Deviation	2	2	2	
	Abduction Deficit	1	1	0	
	Bilateral ptosis	1	0	0	
Anterior Segment	No Abnormality	23	11	5	0.302
	Bilateral Cataracts	0	1	0	
	No Abnormality	20	11	5	
Posterior Segment	Optic Nerve Head Hypoplasia	1	0	0	0.869
	Optic Atrophy	2	1	0	
	Incorporated for Examination	14	10	4	
Visual Acuity Method	Lea Symbols	5	2	1	0.447
	Snellen Visual Acuity	4	0	0	
	0.0	3	1	0	
	0.4	1	0	0	
Visual Acuity LogMAR	0.6	3	1	1	0.856
	0.8	2	0	0	
	NA	14	10	4	

DISCUSSION

In our study, we examined 40 patients with CP with male predominance (72.5%). It is in contrast to the study conducted by Katoch S, et al, who conducted almost similar gender distribution.[7] It can be attributed to gender bias in our society or genetic factors. Our study included individuals aged 6 months to 16 years. Among the patients, Spastic CP was the most prevalent (57.5%), followed by hypotonic (30%) and mixed (12%), consistent with Olubunmi et al.'s findings.[8] Strabismus was the most frequent abnormality in our study, accounting for 82.5% of patients. In contrast, a study found refractive errors to be the most common ocular abnormality followed by strabismus.[9]

Thirteen (32.5%) patients have refractive errors, out of which hypermetropia is present in 8 (20.0%) patients and myopia in 4 (10%) patients. Astigmatism alone was found in 1 (8.3%) patient. Katoch et al, reported astigmatism (34%) as the most common refractive error, followed by hypermetropia (20%) and myopia (13.5%).[7] Several factors, such as children's inability to comprehend the procedure, inattention, fatigue, and uncooperativeness during tests, may contribute to these differences. The mean VA was 0.6 LogMar with a range of 0.0 to 0.8 LogMAR. There is limited data about the prevalence of visual impairment in the population with CP, especially regarding the severity of visual impairment, due to the heterogeneity of the studies and different definitions of severe visual impairment.[10]

Assessing visual acuity and best-corrected visual acuity in children with cerebral palsy is challenging. We checked VA in CP children older than 4 years of age. We could not check visual acuity with Snellen's chart or Lea symbols in younger CP patients. It could be due to the impaired cognitive function in younger patients. Older patients showed cooperation because of improved cognition which might be attributed to the cognitive therapy they received. However, we didn't collect data on any cognitive therapy the patients were undergoing through. In uncooperative and non-verbal children, visual function assessment could be performed with visual evoked potential, although it was not available in our setup. Two (5%) patients had limited abduction. In contrast, Fazzi et al. found a high prevalence of ocular motility disorders in 57.3% of the eyes.[11] We observed ptosis in 2% of the children in our study, consistent with the findings reported in other studies.[12] The fundus was normal in 90% of patients, while optic atrophy was present in 7.5% and optic nerve head hypoplasia in 2.5% of patients in our study. The

prevalence of optic atrophy was higher in our study compared to other studies. A study found disc pallor/atrophy in 3% of patients.[13] Another study found optic nerve hypoplasia in a greater percentage of patients with CP which is 9%.[14] Eye disorders are frequently observed in males as compared to the female population.[15] Our study had limitations, such as difficulties in performing tests on children with CP and especially in assessing VA. The availability of visual evoked potential and other tests for checking visual acuity in preverbal children can solve this problem.

CONCLUSION

Children with cerebral palsy are at a higher risk of developing ocular abnormalities. Living with cerebral palsy can present challenges, but many individuals with CP lead fulfilling and productive lives. Regular ophthalmic and systemic examinations are essential to detect and manage ocular and systemic issues promptly. Early intervention and ongoing therapies are crucial in helping individuals with CP to optimize their physical abilities and improve their quality of life. Treatment plans often involve a multidisciplinary approach, including physical therapy, occupational therapy, speech therapy, assistive devices, and sometimes surgery to address specific issues. Awareness among healthcare providers and parents is crucial for early intervention and improved quality of life for these patients. Managing underlying disorders, such as refractive error correction and visual rehabilitation, can reduce morbidity in children with cerebral palsy. Parents/guardians need counseling for the comprehensive development of children with CP. With the right support, adaptive strategies, and advances in medical and assistive technology, people with cerebral palsy can achieve their goals and participate in various aspects of society.

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Additional Information

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AUTHORS CONTRIBUTIONS

Sr.#	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1.	Nazli Gul	Study design and methodology, manuscript drafting and approval.
2.	Muhammad Rizwan	Paper writing, critical review, and manuscript approval.
3.	Yasmeen	Data collection, analysis and manuscript approval.
4.	Momina Haq	Analysis of data and interpretation of results and manuscript approval.
5.	Anam Haq	Literature review and referencing and manuscript review and approval.
6.	Imran Ahmed	Editing and quality insurance, drafting and manuscript approval.