LIST OF PUBLICATIONS


REFRACTIVE ERRORS VS TYPES OF CEREBRAL PALSY: AN OBSERVATIONAL STUDY IN VARIOUS SCHOOLS FOR CHILDREN WITH SPECIAL NEEDS

Jaya Rajini Vasanthis, Namita Jacobh, S.Vishwanathih

ABSTRACT

Purpose: To report various types of refractive error based on its frequency of occurrence in different types of Cerebral Palsy (CP).

Background: This study has been conducted in the school for special children in and around Chennai, Tamilnadu, India. The study aimed to document the occurrence of refractive error in various types of CP and the result of appropriate correction. This paper reports on the relationship between the types of CP and the different refractive errors present.

Methods: Three hundred and thirty-two cerebral palsy children were recruited in this study. Their visual functions were assessed including Visual acuity, Refractive error, Squint, Accommodation and Visual field. Depending on the age, co-operation and cognitive ability of the child, visual acuity was measured using LEA Paddles and symbols. Visual fields assessment was done with the help of LEA flicker wand. To identify the squint of the children, Hirschberg test and cover test were performed. Routine static retinoscopy was performed both in dilated and undilated state. Children were dilated with 1% Cyclopentolate Hcl and Tropicamide. Refractive error was corrected based on their dilated static Retinoscopy value as the undilated Retinoscopy value will be unreliable because of Accommodation. Ethics committee clearance was obtained as human subjects were involved in the study.

Results: According to our study, 6-48 years was the mean age of the children with CP. Irrespective of types of CP 57% of them were astigmatic, 20% of them were hyperopes, 19% of them were Myopes and only 4% of them were Emmetropes. Among Astigmats 40% were Quadriplegic, 34% were Diplegic, 9% were Ataxic, 7% were Hemiplegic, 6% were Monoplegic, 3% were Athetosis, 1% was Floppy type. CP was classified based on Gross Motor Function Classification system (GMFCS) and Biannual Fine Motor Function (BFM).

Conclusion: This study shows that astigmatism was the most common refractive error among children with CP.

Key words: BFM classification, cerebral palsy, cover test, GMFCS classification, refractive error, visual acuity.

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INTRODUCTION

Children with special needs, particularly those with cerebral palsy (CP), are at a higher risk of visual and eye health problems than their peers.78 These children may receive various interventions through their schools systems including occupational, physical, and/or speech therapy. However, in most cases, they do not receive a comprehensive eye and vision examination. Frequently, those with special needs who have vision or eye health problems may be asymptomatic or unable to express the presence of symptoms.83 Since children with special needs often cannot communicate symptoms adequately, it is important for the professionals who treat these children to be aware of the possible ocular and visual disorders that are frequently present. Often, those involved with a child's care may be the first to suspect a problem.89

Cerebral palsy has different types. They are Spastic cerebral palsy, which is the commonest type of all occurs when the cerebral cortex gets damaged. Spastic Monoplegia is a deficiency of movement of one of the limbs of the body.

CORRESPONDING AUTHOR

Ms. JAYARAJINI S
Assistant Professor in Optometry
Department of Ophthalmology
Sri Ramachandra University, Porur, Chennai-600116
Email Id: harshrajani@yahoo.com

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Spastic Diplegia affects both the legs of a patient. In Hemiplegia any one side of the body gets affected. All the four limbs are affected in Quadriplegia. It is characterized with more severe motor dysfunctions than other forms of CP. Ataxoid type of CP is regarded as uninhibited, sluggish, winding movements.80 Ataxic is an unusual type that affects the stereopsis and equilibrium sensation. Patients having more than three forms of CP are considered to be mixed type.

As CP is a disorder of motor function, oculomotor functioning is often affected and accommodative function is reduced.104 Motor function may not be the cause for accommodative dysfunction in children with CP. However, accommodation can be reduced due to decreased vision, high refractive errors, and strabismus.

In general, assessment of visual acuity is done with high contrast test-charts; but, in real life, visual information is seldom at high contrast level, as we use intermediate and low contrast levels.12 For example, visual functioning at low contrast is very essential for communication as facial expressions require that we see thin faint lines at the edges of the mouth and eyes.

The proportion of prematurity related CP is lower and birth and infection related factors are higher than in Northern/developed country from where we have most research. Therefore we must study the children from our population. Efficient visual functioning is very important for learning and development of children.12 Therefore, this study would focus on assessing the visual functions in children with CP.
METHODS

A prospective observational study was conducted in schools for children with special needs in and around Chennai, Tamilnadu, India. The study evaluated various aspects of vision, subjectively and objectively. Children in different centers of SPASTN (Spastic Society of Tamilnadu) were recruited for the study. Children from Vidhyasudha (School for children with special needs) and KCDU in Sri Ramachandra University, Chennai, Tamilnadu were also included in the study. A detailed history about the child was noted and printed permission was acquired from the subject’s parent. Children with CP based on physician’s diagnosis, school records, and disability certificate information were included. Children ranging from birth to 18 years were included in the study. Those who were having motoric impairments that were not diagnosed as CP were excluded.

Depending upon the maturity, cooperation and cognitive ability, LEA Paddles and LEA Symbols were used to evaluate the visual acuity. Cycloplegic retinoscopy was then performed by instilling 1% Cyclopentolate HCL and Tropicamide. Based on the cycloplegic values refractive error was ascertained and glasses were prescribed accordingly. One hundred and fifty three prescriptions were prescribed out of three hundred and twenty six subjects. Visual acuity was measured with the glasses in the following visits. There was a good compliance with the glasses. Visual acuity was improved compared to the previous visit.

Table 1: Criteria for five levels of Gross Motor Function Classification system (GMFCS) and Biannual Fine Motor Function (BFMF), relevant for age’s studied[11]

<table>
<thead>
<tr>
<th>GMFCS</th>
<th>BFMF</th>
</tr>
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<tbody>
<tr>
<td>Level I</td>
<td>One hand manipulates without restrictions. The other hand manipulates with restrictions or limitations in more advanced fine motor skills.</td>
</tr>
<tr>
<td>Walks without restrictions, limitations in more advanced gross motor skills.</td>
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<tr>
<td>Level II</td>
<td>Level II</td>
</tr>
<tr>
<td>Walks without restrictions, limitations walking outdoors and in the community.</td>
<td></td>
</tr>
<tr>
<td>a) One hand manipulates without restrictions. The other hand only ability to grasp or hold.</td>
<td></td>
</tr>
<tr>
<td>b) Both hands: Limitations in more advanced fine motor skills.</td>
<td></td>
</tr>
<tr>
<td>Level III</td>
<td>Level III</td>
</tr>
<tr>
<td>Walks with assistive mobility devices, limitations walking outdoors and in the community.</td>
<td></td>
</tr>
<tr>
<td>a) One hand manipulates without restrictions. The other hand: no functional ability.</td>
<td></td>
</tr>
<tr>
<td>b) One hand: Limitations in more advanced fine motor skills. The other hand: Only ability to grasp or worse.</td>
<td></td>
</tr>
<tr>
<td>Level IV</td>
<td>Level IV</td>
</tr>
<tr>
<td>Self-mobility with limitations, children are transported or use power mobility outdoors and in the community.</td>
<td></td>
</tr>
<tr>
<td>a) Both hands: Only ability to grasp.</td>
<td></td>
</tr>
<tr>
<td>b) One hand, Only ability to hold. The other hand: Only ability to hold or worse.</td>
<td></td>
</tr>
<tr>
<td>Level V</td>
<td>Level V</td>
</tr>
<tr>
<td>Self-mobility is severely limited, even with the use of assistive technology.</td>
<td></td>
</tr>
<tr>
<td>Both hands: Only ability to hold or worse.</td>
<td></td>
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</table>

RESULTS

Among the 332 children 69.16% were spastic, 24.1% were athetoid, 7.23% were ataxic, 1.2% were floppies (Fig. 1). Findings reveal that the age of the children middle 6.48 years, irrespective of type of CP 56% of them were astigmats, 19.5% of them were hyperopes, 4.5% of them were myopes and only 18% of them were Emmetropes (Fig. 2). Among emmetropes 35% were Quadriplegic, 36.67% were Diplegic, 6.67% were Ataxic, 13.31% were Hemiplegic, 3.33% were Monoplegic, 3.33% were Athetosis, and 1.67% was floppy type. Among Astigmas 40.10% were Quadriplegic, 34.38% were Diplegic, 8.85% were Ataxic, 7.29% were Hemiplegic, 5.73% were Monoplegic, 2.60% were Athetosis, 1.05% was floppy type. Among myopes 46.66% were Quadriplegic,
Refractive and Accommodative status among the children with Cerebral Palsy in three special schools of Chennai and the impact of the optical intervention on the visual acuity and accommodative response.

13.33% were Diplegic, 6.67% were Ataxic, 20% were Hemiplegic, 6.67% were Athetoid, and 6.67% were floppy type. Among Hyperopes 38.46% were Quadriplegic, 41.54% were Diplegic, 3.08% were Ataxic, 10.77% were Hemiplegic, 6.15% were Monoplegic. CP was classified based on GMFCS and BFMF classification (Table 1).

**DISCUSSION**

A Cerebral Palsy child has an inability to control motor function which includes spasm or muscle tightness, disorder in mobility and gait. The major cause for this is brain damage which can occur prenatally or postnatally. Factors that can cause cerebral palsy are deficiency of oxygen, illness, poisoning, and head injury.

Also they may have impaired motor function, strange sensations, and perception, breathlessness because of postural difficulties, ocular & auditory disorders, epilepsy, developmental delay, and dyslexia.

Assessment of visual field in children with CP is often a difficult task, where it demands cognitive skills and eye-hand coordination. Diplegic or tetraplegic CP conditions often cause problems in measurement of visual fields, as they have postural and fixation difficulties. In general, subjectively experienced field is better than the field depicted by clinical tests. Clinical tests measure visual field at a very low luminance level, 5-15 cd/m2, which is a luminance level border between photopic and mesopic vision. But we use our vision at daylight luminance levels in most tasks. The interpretations of perimetry examinations may or may not depict the functional visual field. As a result, usual clinical measurements are quite often misleading. Lightening conditions and changing colors ensure that few things are ever similar to testing situations. Hence the test situation cannot be standardized; visual fields can be assessed approximately by confrontation technique in children with CP.

On the other hand, CP children had decreased visual acuity, which was accompanied by impairment in visual perception, deprived control of extra-ocular muscles, greater prevalence of strabismus and nystagmus are all likely to be contributing factors.

Fant and Perlestein stated an increased incidence of myopia in spastic children and frequency of hyperopia was high in dyskinesia. Kozak and Anogianakis et al. accounted 40.5% of astigmatism whereas 50% occurrence in study of Govinda and Lamba which is similar to the observation of our study (43.15%). Early predominance of refractive error implies hindered emmetropization. Findings of refractive error in Down syndrome correlates with our study.

This shows that further researches need to be carried out to identify the progress of ametropia in CP.

Ametropia was the most widespread abnormality acknowledged (79%) which shows disparity in Govinda et al. study (N = 70) where ocular deviation (35.7%) to be the most common defect. Various prevalence of abnormal refractive errors in patients with cerebral palsy, ranges between 28.5% to 54% in other studies. Moreover, only 25% of our children were using habitual correction when first examined. This emphasizes the need for suitable medical appointment and supervision of refractive problems, and guiding the parents for the need for vision care in CP children. Much of the literature quotes a higher prevalence of hyperopia in cerebral palsy. Our study agreed with the prior studies. We found the incidence of myopia and hyperopia to be considerably larger than that reported in normal children.

**CONCLUSION:**

Refractive error may change considerably within the first two years of age. Ocular abnormalities are very common in children with CP. Our findings shows 192 subjects have astigmatism which are similar to previous studies in the literature and confirm that children with CP are at more risk of developing ocular abnormalities. Parents and the health practitioners who are responsible for the health and overall development of children with CP should be aware of the ocular defects that may be present in these children. Early intervention will help for the child’s physical, social, academic, and visual development. A full eye examination should be sought as soon as a diagnosis of CP is made and yearly thereafter.

**REFERENCES**

List of Publications

Article ▶ Visual Function Status in Children with Cerebral Palsy

Jaya Rajani Vasanth, Sri Ramachandra Medical College & Research Institute, Porur
Namaia Jacob, Vidhyasagar Institute for Special Children
S. Viswanathan, Sri Muthukumaran Medical College, Mangadu

ABSTRACT

Background: This study was conducted in the school for special children in and around Chennai, Tamilnadu, India. The study aimed at giving an appropriate refractive correction for the children with special needs.

Methods: Three hundred and seventy-six children with cerebral palsy were assessed. Visual function and accommodative status was evaluated. Visual acuity was assessed using LEA paddles and LEA symbols depending upon the age, cooperation, and cognitive ability of the child. Visual fields were assessed by using LEA flicker wand. The Hirschberg and cover tests were done to identify strabismus. Mothindra near retinoscopy was done to find the static refractive status of the children followed by cycloplegic refraction. Accommodation was measured using a modification of MEM and Nott dynamic retinoscopy technique. The values were compared with the age-matched normal values.

Results: The mean age of the children was 6.48 years. Near normal vision was observed in 12.67%, 43.66% had moderate low vision, 26.76% had severe low vision, and 16.91% had profound low vision. Strabismus was present in 43.89% of the children. Among those who had strabismus, nystagmus was present in 7.45%. The accommodative status was assessed by MEM and Nott dynamic retinoscopy. The findings were as follows: lead of accommodation (18.60%), lag of accommodation (50.27%), and normal accommodative status (31.13%).

Conclusion: This study shows that most of the children with cerebral palsy have a lag of accommodation. Hence, refractive error was corrected accordingly, considering their binocular status. The importance of testing binocular and accommodative status in children with special needs cannot be understated.

Keywords: accommodation, binocularity, cerebral palsy, cover test, refractive error, visual acuity, visual field testing.

Introduction

Children with special needs, particularly those with cerebral palsy (CP), are at a higher risk for visual and eye health problems than their peers. These children may receive various interventions through their school systems, including occupational, physical, and/or speech therapy. However, in most cases, they do not receive a comprehensive eye and vision examination. Frequently, those with special needs who have vision or eye health problems may be asymptomatic or unable to express the presence of symptoms. Because children with special needs often cannot communicate symptoms adequately, it is important for the professionals who treat these children to be aware of the possible ocular and visual disorders that are frequently present. Often, those involved with a child’s care may be the first to suspect a problem.

Cerebral palsy describes a group of disorders of the development of movement and posture, causing activity limitation; those are attributed to non-progressive disturbances that occurred in the developing foetal or infant brain. The motor disorders of CP are often accompanied by disturbances of sensation, cognition, communication, perception, and/or behavior, and a seizure disorder. The diagnosis of CP is usually made on the basis of uncoordinated muscle movements and delays in reaching developmental milestones. In addition to a physical examination, computerized tomography and/or magnetic resonance imaging of the child’s brain to look for the brain insults and abnormalities may help to diagnose the condition. The assessment and management of visual disorders in physically or intellectually impaired children represent a complex challenge for the clinician. Refractive errors, nystagmus, and strabismus often greatly affect the quality of vision of cerebral palsy patients. The earlier the diagnosis can be made and appropriate management instituted, the more the children will be helped in their learning and academic success.

Methods

This study was conducted in the school for children with special needs in and around Chennai, Tamilnadu, India. The study evaluated various aspects of vision, subjectively and objectively. Children from three different schools were included in the study. A detailed history about the child was noted, and written consent was obtained from the subject’s parents. A diagnosis of CP was based on physician’s diagnosis, school records, or disability certificate information. Children ranging from birth to 18 years were included in the study. Those who were having motoric impairments that were not diagnosed as CP were excluded.

Visual acuity was assessed using LEA paddles or symbols and Central, Steady, Maintain (CSM) technique depending upon age, cooperation, and cognitive ability. LEA paddles were
used for preferential looking situations. The handle on each paddle allows the tester easily to administer the test. Grating levels printed on each handle are 0.25, 0.5, 1.0, 2.0, 4.0, and 8.0 cpm (cycles per centimetre of surface). LEA symbols are used to measure the smallest size of the optotypes that an individual can recognize. They are available in 5 contrast levels: 1.25%, 2.5%, 5%, 10%, and 25%. Acuity is tested at a 10 foot (3 meter) testing distance.

Visual fields were assessed using the LEA flicker wand. The LEA flicker wand is 26.5° (67.3 cm) long with a 20° (50.8 cm) flexible wand with a diode at the end that can be used as a flickering or non-flickering stimulus at 4, 40, and 400 cd/m². The curved wand is moved from behind the person forward in all four quadrants of the visual field to detect losses in the periphery of the visual field.

The Hirschberg and cover tests were performed to identify the presence of strabismus. The position of the corneal reflexes in both eyes under binocular conditions was noted, and the position of the reflex in monocular conditions was compared using a penlight. The unilateral and alternating cover tests are done to elicit any manifest or latent deviations.

Cycloplegic retinoscopy was done by instilling 2 drops of 1% cyclopentolate and 1 drop of tropicamide in each eye. Retinoscopy was performed after half an hour from the instillation of the last drop when accommodation will be at rest.

The accommodative status was measured using a modification of the Monocular Estimation Method (MEM) and Nott dynamic retinoscopy technique. The Nott method was used to measure the accommodative lag at near under binocular conditions. Nott dynamic retinoscopy is performed while the patient attends to a near target through the distance or near fixation; the observer views from a position above the near target and slightly temporal to the midline. Initially, the retinoscope aperture is located behind the near target, farther from the patient. The position of the near point (punctum proximum) is located and bracketed by moving the retinoscope aperture away from or toward the patient’s eyes.

Monocular Estimation Method is performed at the patient’s customary reading distance with the distance correction being worn. The fixation target, words or symbols on a small white card, is fixed at the retinoscope itself. Retinoscopy is performed along one meridian. If with motion is present it indicates a lag of accommodation, while against motion indicates a lead of accommodation. This motion is neutralized using lenses dropped and removed quickly from the patient’s field of view. The values of the MEM retinoscopy were compared with the age-matched values.

**Results**

A total of 374 children with CP ranging in age from 5 to 216 months (mean age: 77.92 months) were included in the study. Among them 54% were males (mean age: 77.99) and 46% were females (mean age: 78.14). Ocular abnormalities were detected in 54.78% of the children. Multiple ocular abnormalities were present in 45.22% of the children.

**Visual Acuity**

Visual acuity was assessed in all the children. Acuity was checked with spectacles if the child was already wearing them. The most frequently used method to assess visual acuity was the Lea gratings (44% of the children), followed by the CSM technique (36%) and Lea symbols (18%). The remaining 2% of the children were lost to follow up. A presenting visual acuity of 6/6 was measured in 12.67% of the children, 6/9 to 6/18 in 43.68% of the children, 6/18 to 6/36 in 26.76% of the children, and 16.91% had visual acuity less than 6/36-6/60. A positive CSM was recorded in 74.21% of the children.

**Visual Field**

Visual field was assessed using Lea flicker wand in all the children. Symmetrical visual fields were found in 74.47% of the children.

**Binocular Function**

Both the cover and Hirschberg tests were done to detect whether any form of strabismus was present or not. The tests revealed that 43.0% of the children had strabismus. Among those with strabismus, 50.44% had exotropia, and 49.56% had esotropia. Nyhagowski was noted in 7.45% of the children.

**Refraction**

Cycloplegic refraction was performed following the routine static dry retinoscopy technique. Findings reveal that 3.26% of the children were myopic, 16.33% were hyperopic, 80.39% had astigmatism, and 1.06% were antimetropic. Among the 80.39% with astigmatism, 49.60% had with-the-rule astigmatism, and 50.40% had against-the-rule astigmatism, which was prescribed to the children as per the age-matched normal values.

**Accommodative Status**

The accommodative status of the children was assessed using MEM and Nott retinoscopy technique. The findings were as follows: lead of accommodation (18.60%), lag of accommodation (50.27%), and normal accommodative status (31.13%).

**Discussion**

The children included in this study were undergoing rehabilitation at their schools regularly, so the routine ocular examination was done in their respective rehabilitation centers. This gave the clinician an important advantage in that the subjects cooperated more fully in the examination because of the familiar environment. Moreover, their teachers were immediately available to be educated about the children’s difficulties and were offered interventional suggestions.
One factor for poor visual acuity might have been some children's relative non-motivation, fatigue, and prolonged inattention to the acuity tests during the testing duration. Moreover, it cannot be said whether the presenting acuity recorded for each child was actually their best acuity or merely the best effort the child could offer. Even the children in whom CSM was positive might have had better visual acuity than estimated. The accurate measurement of visual acuity in cerebral palsy patients is a difficult task. For most children in this study, reliable methods of assessing visual acuity like Lea paddles and symbol chart were used. The less reliable and qualitative vision assessment method, the CSM technique, was used in the remainder.

A spectrum of visual disorders is prevalent in children with CP and has been described extensively in the literature.1,2,8,13-15-19 Our findings are in agreement with the higher figure, showing a prevalence of 79.6%. In this study, 300 children had more than one visual deficit. 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 persons diagnosed with CP.

Refractive error, as defined in this study, was the most common type of abnormality documented (79%).10 This is in contrast to the study by Govinda et al, who found strabismus (35.7%) to be the most frequent abnormality. However, prevalence rates of abnormal refractive errors in patients with CP (28.5% to 54%) have been reported in other parts of the world.5,8,13,17,19,21 Moreover, only 25% of our children were wearing spectacles when first examined. 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.1,2,5,10,12,20,22 Most of the literature quotes a higher prevalence of hyperopia in cerebral palsy.1,18 Our study agreed with the prior studies. We found the incidence of myopia and hyperopia to be considerably larger than that reported in normal children. Fant and Perlstein report a higher prevalence of myopia in those with spastic CP and found that hypermetropia was more prevalent in CP with dyskinesia.22 The prevalence of astigmatism in our study population (43.13%) is similar to several previous studies. Konis and Anastakis et al.16,23 reported the incidence of astigmatism to be 40.9%, and Govinda and Lamba reported an even higher incidence (50%).22 The higher prevalence of refractive error, even in the lower age group, suggests that the enmetropization process may have been hampered. Our findings on the prevalence of refractive error were similar to the findings in children with Down syndrome. As the present study shows a significant prevalence of refractive errors, additional studies should be conducted in order to understand the development of refractive errors in CP in our context.

The prevalence of strabismus observed in the present study (36.83%) matches well with other parts of the world (India-35.7%, 39% Japan-33.1%; Africa-50%)2,5,8,10,13,15,16,18,21,25 Alternating exotropia was seen to occur more frequently in CP patients than in normally developing children. Various ranges for the incidence of nystagmus have been reported in CP (1.02% - 18%),5,10,13,15,16,26 and our study agrees with this range (7.45%).

The accommodative status found shows that most of the children with CP have a lag of accommodation (50-275)10 and hence the refractive error was corrected accordingly considering their binocular status.26 Both MEM and Non-dynamic retinoscopy techniques showed similar findings.

**Conclusion**

Ocular abnormalities are very common in children with CP. Our findings are similar to previous studies in the literature and confirm that children with CP are at more risk of developing ocular abnormalities. Parents and the health practitioners who are responsible for the health and overall development of children with CP should be aware of the ocular defects that may present in these children. Early intervention will help for the child’s physical, social, academic, and visual development. A full eye examination should be sought as soon as a diagnosis of CP is made and yearly thereafter.

Thorough ocular assessment of subjects with CP can be difficult. However, familiar surroundings, a caring environment, and adequate clinical attention can facilitate assessment of all the visual disorders of these patients. Early referral of the children diagnosed with cerebral palsy for ocular examination is of utmost necessity for better visual prognosis.

**References**

List of Publications


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