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Original Research Article

PREVALENCE OF HIP SUBLUXATION/DISLOCATION IN CHILDREN WITH CEREBRAL PALSY IN RELATION TO SEVERITY AND TYPE OF CEREBRAL PALSY

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Abstract

Background: Hip displacement is common in cerebral palsy (CP) and is related to the severity of neurological and functional impairment. It is a silent, but progressive disease, and can result in significant morbidity and decreased quality of life. The objective is to know the prevalence of hip displacement /dislocation in CP children and to establish correlation between hip displacement / dislocation with GMFCS level and clinical subtypes of CP. **Materials and Methods:** The present observational descriptive study was conducted among children of the age between 1 and 16 years diagnosed with CP or those children not yet diagnosed with CP but for whom there is clinical suspicion of having CP in Department of Orthopaedics and Department of Physical Medicine and Rehabilitation (PMR), at Karnataka Institute of Medical Sciences, Hubballi, during the period of December 2019 to November 2021. **Result:** Out of 100 children, 56 males and 44 females are there. Major topographical subtype was spastic variety. Among spastic subtypes, 54% had spastic quadriplegia. majority of children belongs to GMFCS level V. Out of 60 patients with GMFCS level V, 44 patients had hip displacement in either one or both hips (73.3%), for level IV, III and II shows hip displacement of 66.6%, 33.3% and 20% respectively. None of the children with GMFCS level I had hip displacement. The relationship between GMFCS and hip displacement is positively correlated (r=0.420,0.506) and it is statistically significant ($p<0.001$).66.6% children with spastic quadriplegia had hip displacement in either one or both hips. The incidence in spastic diplegia and hemiplegia is 54.4% and 33.3% respectively, which is statistically significant($p<0.001$) and positively co-related (r = 0.322,0.534). **Conclusion:** Hip displacement is common in children with cerebral palsy, with an overall incidence of 54 % found in this study. The maximum number of hip displacements was seen in children with spastic quadriplegia. Spastic diplegia had intermediate risk and spastic hemiplegiahad low risk.

INTRODUCTION

Cerebral palsy, which has an incidence of approximately two per 1000 live births, is the most common cause of physical disability affecting children.[1]The condition poses considerable diagnostic and therapeutic challenges to the physician with degree of involvement ranging from mild with minimal disability to severe, associated with several comorbid conditions. It is a "symptom complex" characterized by heterogenous presentations, evolutions, etiologies, comorbid conditions, functional implications, service needs and outcomes.[2]

Hip displacement is thought to be common in children with cerebral palsy and may progress from silent subluxation to painful dislocation when left untreated.[3]

The current definition of cerebral palsy (CP) describes it as a group of permanent 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 brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication and behavior, by epilepsy, and by secondary musculoskeletal problems.[4] This is the most widely accepted definition now. This definition covers a wide range of clinical presentations and degrees of activity limitation. Thus, it is helpful to categorize individuals with CP into classes or groups.

Cerebral palsy may be classified according to motor type, topographical distribution, and functional severity. The motor types can be described as spastic, dystonic, mixed, ataxic, or hypotonic, and the definitions of each type have recently been updated.[1,5]

The most common topographical distributions are spastic hemiplegia, spastic diplegia, and spastic quadriplegia.[1,6] Spastic hemiplegia is characterized by unilateral involvement, and spastic diplegia and spastic quadriplegia are characterized by bilateral involvement. However, neither the descriptors nor the definitions of the terms for motor type and topographical distribution have been agreed upon. Furthermore, it is known that classifications based on motor type and topographical distribution may not be reliable.[1,7]

The most useful development in the classification of cerebral palsy in recent years has been the creation of the Gross Motor Function Classification System (GMFCS).[8] The GMFCS is a five-level ordinal grading system based on the assessment of self-initiated movement with emphasis on function with regard to sitting and walking.

Unlike the classifications of motor type and topographical distribution, the GMFCS has been confirmed in a number of studies to be a valid, reliable, stable, and clinically relevant method for the classification and prediction of motor function of children with cerebral palsy between the ages of two and twelve years.[9]

The second most (most common is the equinus deformity) frequent complication in cerebral palsy patients is hip displacement, with an incidence of 15% to 35%. The rate of hip subluxation in this population varies with their functional level.[10]

Hip displacement in children with cerebral palsy is usually attributed to spasticity and contracture of the hip adductors and flexors as well as the medial hamstrings. This may result in muscle imbalance as well as osseous deformity, including increased femoral anteversion and acetabular dysplasia, which further increases the risk of hip instability.[11]

Some centers have established surveillance programs to identify the “hip-at-risk” in patients with cerebral palsy, so that treatment may be implemented prior to the onset of symptomatic dislocation.[12] Effective programs must be based on an understanding of the incidence and natural history of hip displacement in cerebral palsy as it relates to disease severity. Familiarity with incidence rates may also help clinicians to be more aware of the relative risk of hip disease when caring for a child with cerebral palsy.

MATERIALSANDMETHODS

The present observational descriptive study was conducted among 100 children of the age between 1 and 16 years diagnosed with CP or those children not yet diagnosed with CP but for whom there is clinical suspicion of having CP in Department of Orthopaedics and Department of Physical Medicine and Rehabilitation (PMR), at Karnataka Institute of Medical Sciences, Hubballi, during the period of December 2019 to November 2021.

Inclusion Criteria

- Children between 1 to 16 years of age who were already diagnosed with CP and newlydiagnosed patients.
- Children with predominant motor delay with spasticity, hypotonia, ataxiaand dyskinesia will be included.

Exclusion Criteria

- Children with age less than one year and more than 16 years
- Normal children
- Children with progressive neurological disorders

Data Collection Procedure: This was an observational descriptive study which included children in the age group of 1 to 16 years of age with a diagnosis of cerebral palsy.

Informed consent was obtained from the parents for all children. Detailed history was obtained from the parents including family history, prenatal, perinatal and birth information.

A detailed general physical examination and systemic examination was done to classify the type of CP. Assessment of gross motor function and severity of cerebral palsy was assessed by using GMFCS and correlation of GMFCS with clinical subtype was noted. GMFCS is a five-level classification system that describes the gross motor function of the children with CP. Severity / motor involvement of the disease can be assessed using GMFCS.

Radiographic evaluation: Standardized radiographs of the pelvis were obtained, with the patient supine, the pelvis as symmetrical as possible, the hips in neutral abduction/ adduction and the lumbar spine flat. [Figure 1] In the presence of fixed flexion deformity of the hip, both hips were flexed until the lumbar spine flattened in order to avoid excessive anterior tilt, which influences the accuracy of acetabular measurement. Prior education and demonstration regarding correct positioning were given to the Medical Imaging Department.

Draw H line (Hilgenreiner’s line) horizontal line between triradiate cartilages, P(Perkin’s line), a line drawn perpendicular to the H-line at the lateralmargin of the acetabulum. Then measuring

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the proportion (%) of capital epiphysis that has migrated beyond Perkin's line laterally.

The primary outcome measure in this study was the presence of hip displacement, defined as a migration percentage of >30% in one or both hips. The migration percentage is measured by drawing a Hilgenreiner's line and Perkin's line on an anteroposterior radiograph of the hips. The amount of ossified femoral head that lies lateral to the Perkin's line is measured, divided by the width of the femoral head, and multiplied by 100, to be expressed as a percentage.

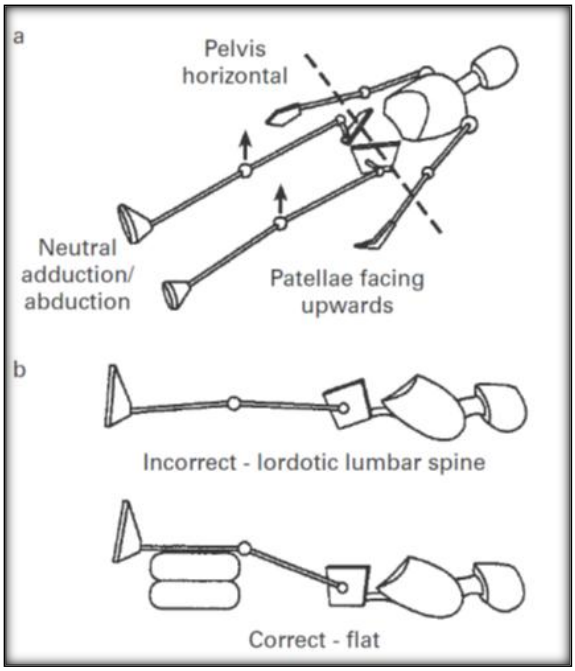

Figure 1

Statistical analysis: All the variables are expressed as frequency and percentages. To obtain theassociation of categorical variables with study subject, Chi square / Fishers exact test was applied. To test the correlation between study variables, Kendall's Tau correlation methods was applied.

RESULTS

Out of 100 patients 28 patients (28%) were in the age group of 1-4, 60 patients (60%) were in the age group of 5-8, 6 patients (6%) were in the age group of 9-12 and 6 patients (6%) was in theage group of 13-16. Out of 100 patients 56 patients were male (56%) and 44 patients were females (44%).

Out of 100 patients 6 patients (6%) comes under GMFCS level I, 10 patients (10%) under level II, 12 patients (12%)in level III, 12 patients (12%) comes under GMFCS level IV and 60 patients (60%) had level V. Majority of the study population had spastic variety of cerebral palsy(88%)

Majority of the study population had spastic quadriplegic variety of cerebral palsy (54%) [Table 1].

Out of 100 children, 56 children (56%) had hip displacement in either one side or both and 2 had hip dislocation [Table 2]

Out of 60 patients with GMFCS level V, 44 patients had hip displacement in either one or both hips (73.3%), for level IV, III and II shows hip displacement of 66.6%, 33.3% and 20% respectively. None of the children with GMFCS level I had hip displacement. Two children with hip dislocation had GMFCS level V. The results were statistically significant. (p value <0.05) [Table 3]

Among spastic CP 54.5% shows hip displacement with two cases of hip dislocation (2.2%). [Table 4]

In our study, 66.6 % children with spastic quadriplegia had hip displacement in either one or both hips. Most displacement cases come under spastic quadriplegia. Two hip dislocation cases were also seen in spastic quadriplegic variety. 54.4% children with spastic diplegia had hip displacement. 33.3% comes under spastic hemiplegic variety. No hip displacement cases were observed in ataxic type of CP. The results were statistically significant (P value- 0.034). [Table 5]

The relationship between GMFCS and hip displacement is positively correlated (r=0.420,0.506) & it is statistically significant (p<0.001). The relationship between clinical subtype and hip displacement is positively correlated (r=0.322,0.534)& it is statistically significant (p<0.001). [Table 6]

Table 1: Cerebral palsy clinical subtypes distribution

Cerebral palsy clinical subtypes	N	%
Ataxic CP	2	2.0
Dyskinetic CP	10	10.0
Spastic hemiplegia	12	12.0
Spastic diplegia	22	22.0
Spastic quadriplegia	54	54.0
Total	100	100.0

Table 2: Distribution of Hip displacement/dislocation in either one side or both (based on Reimer's index)

Hip dislocation	N	%
Normal	42	42.0
Hip displacement	56	56.0
Hip dislocation	2	2.0
Total	100	100.0

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Table 3: Association of GMFCS with hip displacement /dislocation(RMP >30)

GMFCS	Hip Dislocation	Hip Displacement	Normal	P value
Level 1	0	0	6 (100.0)	0.014
Level 2	0	2 (20.0)	8 (80.0)	
Level 3	0	4 (33.3)	6 (50.0)	
Level 4	0	8 (66.6)	3 (33.3)	
Level 5	2 (3.2)	44 (68.8)	18 (28.1)	

Table 4: Association of muscle tone with hip displacement / dislocation

Muscle tone	Hip Dislocation	Hip Displacement	Normal	P value
Hypotonic	0	0	2 (100.0)	0.291
Dyskinetic	0	3 (30.0)	7 (70.0)	
Spastic	2 (2.2)	48 (54.5)	38 (43.1)	

Table 5: Association of clinical subtypes of CP with hip displacement /dislocation

Clinical Subtypes of CP	Hip Dislocation	Hip Displacement	Normal	P value
Ataxic CP	0	0	2 (100)	0.034
Dyskinetic CP	0	3 (30.0)	5 (70.0)	
Spastic diplegia	0	12 (54.5)	10 (45.4)	
Spastic hemiplegia	0	2 (16.6)	10 (83.3)	
Spastic quadriplegia	2 (3.7)	36 (66.6)	16 (29.6)	

Table 6: Correlation between GMFCS and Reimer's index

	GMFCSCorrelation coefficient	P value
Reimer's index Right	0.506	<0.001
Reimer's index left	0.420	<0.001

DISCUSSION

Majority of the study population were under 8 years of age. Almost similar distribution was found in a study conducted by Muzaffar et al where, majority (78%) cases come under the age of 7 years, 20% were >7-12 years, and in age group more than 12 years, distribution was2%.[13]

In a largescale study conducted by Minciu et al on 379 kids with CP, almost similar distribution of 55.5% was found among children between 1-2 and 3-5years,26.4% were in the age group of 6-10 years and >10 years age group, distribution was 17.7%.[14]

Majority in our study population were male children 56 (56%) and female children were 44(44%). Similarly, male preponderance was found in studies conducted by Minciu et al (1.38:1)and Muzaffar et al (3:2).[13,14]

It is comparable to other studies done in which spastic cerebral palsy was the commonest type, Singhi P et al,[15]showed 70%,Srivatsava VK et al,[16] showed 91.4%.

Regarding the type of CP, it was comparable with studies by Singhi P et al,[15] (50%), and Srivatsava VK et al (38.4%),[16] were patients presented with spastic quadriplegic CP is comparable to this study, where spastic quadriplegic type of CP is the commonest ie ,54%.

Similar distribution was observed by Shevell et al,[17] where majority (35%) were spastic quadriplegic type and only 4% were ataxic hypotonic type.

Children who can walk without any limitations were categorized as GMFCS I. Among 100 children, 6 (6.0%) was GMFCS level I. Children who can walk but withlimitations wasGMFCS II ,10 children (10%) come under this level in our study. GMFCS level III was those who can walk using a hand-held mobility device and GMFCS IV was self mobility with limitations. 12 children (12%) was GMFCS III level and 12 children(12%) with GMFCS level IV in our study. Both III and IV are equal in number in our study.

Venkateshwaran and companions in a study among 92 children spastic cerebral palsy founds imilar distribution, that majority (46.7%) were GMFCS V81.In a study conducted by Muzaffar et al,[13] where GMFCS level II was26% followed by GMFCS V (23%).

The majority of previous studies support a migration percentage of >30% as a suitable definition of hip displacement10.Hip with such displacement are clearly abnormal, and the displacement is liable to progress in children with severe involvement.[18]

In our study out of 100 children, 54 children (54%) had MP > 30%,either in one or both hips, and only 2 children had fully dislocated hip (2%), ie. MP – 100% and most displacement occurs before seven years of age.

The prevalence of hip displacement is estimated to occur in 25 to 60%, while complete hip dislocation reported to be between10 and 15%.[12] Our study yielded similar finding with 54% children with hip displacement in either one or both hips and complete hip dislocation in 2%.

Some children showed lateral displacement already at two years of age.This means that it is of the utmost importance that children with CP are identified early, and that children at risk are examined radiographically as early as possible.

Scrutton and Baird,[19] recommended that children with spastic diplegia or quadriplegia should have a first radiograph at age 30 months. Based on our findings we recommend that children with highest

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risk should have their first radiographic examination even earlier, if possible.

The risk of hip displacement varied according to CP-subtype.

In our study 36 children out of 54 quadriplegic CP(66.6%) had hip displacement.2 children out of 12 (16.6%) with spastic hemiplegia had hip displacement and in spastic diplegic type it is 54.5%. In dyskinetic type of CP the incidence of hip displacement is 30%.2 children with ataxic type of CP had normal hips.

The incidence ofhip displacement in children with spastic quadriplegia reported inthis study(66.6%) is comparable with incidence rates of 60%to 80% reported in previous studies.[11]

According to Soo et al the risk of hip displacement was related to topography,with a 1% risk in children with hemiplegia compared toan 82% risk in children with quadriplegia, and the incidence of hip displacement was unrelated to themotor type, as children with spasticity and dystonia hadthe same risk as children with hypotonia.[10]

Children with GMFCS level-I function are completely independent, do not use aids, usually have a mild spastic hemiplegia, and do not have hip displacement. Therelatively normal muscle tone and high level of activity seems to be protective against hip disease.

In contrast, children with GMFCSlevel-V function lack head control, have no sitting balance,have no independent mobility, and usually have severe spastic in a quadriplegic pattern. Such children have 90% incidence of hip displacement. The combinationof severe bilateral spasticity and immobility may be responsiblefor the very high incidence of hip displacement in these children. The incidences of hip displacement associatedwith GMFCS levels II, III, and IV are intermediate between these two extremes.

A population study done by Scrutton and Braid on 1997 tomonitorhip development in children with cerebralpalsy found that at five years of age,54%of children not walking independently hadone or both hips subluxated.[12]

In the first population-based study using the AustralianCP Register, Soo et al. confirmed the linear correlation between hip displacement and the GMFCS level.Throughout childhood, the risk for hip displacement was determined to be approximately 15% for GMFCS level II,40% for level III, 70% for level IV and 90% for level Vchildren

Soo etal(2006) reported that at Gross Motor FunctionClassification System (GMFCS) Levels IVand V, rates of hip displacement were 69%and 90%, respectively.[10]

A nearly straight-line relationship between the rate ofhip displacement and the GMFCS level was apparent.This suggests that the GMFCS provides a reliable representation of motor function and further substantiates its use in the classification of the severity of cerebral palsy.[20]Understanding the relationship between the GMFCS and the traditional motor-type and topographical classifications is important to appreciate the utility of the GMFCS and to provide a reference point for its use.[21]

The descriptors for the motor types of cerebral palsy have not been universally agreed on;new definitions are under development, and the definitions may be difficult to apply in a reliable manner.[10]Dystonia may develop for the first time in late childhood or adolescence in a child previously described as having a spastic motor type.[22]

CONCLUSION

It was concluded that hip displacement is common in children with cerebral palsy, with an overall incidence of 54% found in this study.Quadriplegic spastic variety of cerebral palsy is the commonest type of CP.The maximum number of hip displacements was seen in children with spastic quadriplegia with highest risk. Spastic diplegia had intermediate risk and spastic hemiplegia had low risk.The risk of hip displacement is directly related to gross motor function as graded with the Gross Motor Function Classification System.This study confirms the high incidence of hip displacement in children with cerebral palsy and the direct relationship with functional level.

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