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Research Article

Prevalence of Scoliosis in Cerebral Palsy

Summaiya Zareen Shaikh[1], Anushree Kailas Gurav[2]

[1]Assistant Professor, [2]Final Year Physiotherapy, Department of Physiotherapy, D.Y. Patil University, Navi Mumbai, Maharashtra, India.

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Corresponding Author:
Anushree Kailas Gurav, Department of Physiotherapy, D.Y. Patil University, Navi Mumbai, Maharashtra, India.
E-mail Id:
anu.gur.bpt16@dypatil.edu
Orcid Id:
https://orcid.org/0000-0001-6183-7515

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A B S T R A C T

Background: Significant structural deformity of the spine often accompanies cerebral palsy. Progression of curve will eventually lead to pain, loss of ambulation, sitting balance. The aetiology of scoliosis in CP has yet to be well defined.

Objective: The objective of this study was to find incidence of scoliosis in different sub-types of cerebral palsy.

Method: A total population of 30 children with cerebral palsy aged 5 to 20 years followed with examination and assessment for scoliosis in a health care setting was analysed. GMFCS level, CP subtype, age at diagnosis, gender dominance of the condition were correlates registered. Effect of 5 factors on progression of the curve and type of scoliosis dominant in cerebral palsy was studied.

Results: Of the 30 subjects initially enrolled in the study, 19 of them with scoliosis in which incidence of 28% was found among spastic quadriplegia followed by 24% in diplegia. The risk of scoliosis increased with GMFCS level and age. 22% of children showed moderate scoliosis with respect to scoliosis appearance questionnaire.

Conclusions: Scoliosis was most common in the spastic group with the highest incidence in the spastic quadriplegics. There was a definite inverse relationship between the level of ambulation and scoliosis: the higher the level of ambulation the lower the incidence of scoliosis. Moderate scoliosis was found because progression of curve is expected to continue until skeletal maturity.

Keywords: Cerebral Palsy, Functional/ Structural Scoliosis, GMFCS Level, Rib/ Flank Prominence, Convexity

Introduction

Cerebral Palsy (CP) is defined as a permanent, non-progressive abnormality of motor function that is a result of injury to the developing brain. It can occur pre, peri or postnatally from a variety of causes. Scoliosis is common in non-ambulatory individuals with Cerebral Palsy (CP).[1] Spasticity, muscle weakness, and incomplete muscle control contribute to impaired trunk control and the development of spinal deformity.[2] The risk is higher in people with total body involvement, for whom an incidence of 64% has been reported.[3] Despite the impact of the problem, little is known about the origin and progression of scoliosis in children with CP.[4] Perhaps the best-documented finding is that scoliosis most frequently occurs in children with severe CP (i.e., in

children functioning at level IV or V of the Gross Motor Function Classification System. [GMFCS].[4] Incidence varies with the extent and severity of the neurologic involvement. Children with CP who are non- ambulatory and have total body involvement have an incidence of scoliosis of 62%; for bedridden children, the incidence approaches 100%.[5] The rotational component of scoliosis creates large rib prominences that are prone to excessive skin pressure from seat surfaces and braces.[5]

It is not known whether the incidence directly parallel to the severity of the neurologic deficit and the aggravating factors when the individuals were artificially placed in the sitting position and whether the definite inverse relationship exists between the level of ambulation and scoliosis: the higher the level of ambulation the lower the incidence of scoliosis.[6] Hip stability per se could not be correlated with the incidence of scoliosis and whether the most important factors in predicting scoliosis in this population are the presence of spasticity and the severity of the neurologic deficit.[6] In many patients with cerebral palsy, scoliosis had not been suspected until a radiograph was taken.[7] Children with cerebral palsy appear usually to have been excluded from the surgical treatment of scoliosis because of their inability to tolerate corrective plasters.[7] Mental retardation often prevents the full cooperation by the patient that is essential for treatment in Milwaukee brace.[7] The effectiveness of bracing for this group has not yet been proved but may include the management of smaller lumbar or thoracolumbar curves in ambulatory patients.[8]

The need of the study was surveillance of scoliosis in children with cerebral palsy is important for early identification and diagnosis and to prevent further progression of curve. Due to pre-existing comorbidities of cerebral palsy itself like spasticity, muscle weakness and poor motor control may contribute to another comorbidity (one leading to another) like impaired trunk control and development of various spinal deformity. This deformities in spine caused due to pre-existing comorbidities can further lead to additional motor dysfunctions, sitting and transfers problem, impaired cardiopulmonary function and pressure sores and pain due to prolong immobilization and reduced quality of life. Therefore, the main aim of the study was to prevent these complications due to comorbidities from arising and to work on the root cause for spasticity, weakness itself and to increase and spread awareness of incidence of scoliosis in a group of people with CP is important in in terms of predicting future risk of scoliosis and identifying susceptible population and providing early intervention.

Materials and Method

The study design was a cross-sectional study and the study population was Cerebral palsy children with scoliosis. The study durations Was 6 months conducted in following institutions DY Patil hospital, Navi Mumbai, NASEOH, Aashray special education school. Ethical clearance was obtained before the study from institutional ethics committee for human research, DY Patil university, Navi-Mumbai, India. The statistical tool used to calculate statistics was SPSS-23. Cerebral palsy children aged between 05-20 years both males and females with GMFCS Level ranging from I-V and those with and without scoliosis were included in the study. Children with congenital scoliosis and presence of any other chronic illness were excluded from the study. The subjects who fulfilled the inclusion criteria was explained about the study and a written informed patient consent was taken from them.

Examination and assessment of scoliosis in CP (Analysis in a study Setting): The subjects or their parents were interviewed face to face by self -made questionnaire based on difficulty and assistance level provided in 5 domains 1) Activities of daily living and self- care 2) positioning/ transfers 3) emotions 4) communication and interaction 5) health

Analysis was made due to scoliosis (if present) how these domains are getting affected in a CP child. So, effect of scoliosis on cerebral palsy and vice-versa was both studied.

Assessment of scoliosis based on scoliosis appearance questionnaire examined children in posterior view for curvature of spine, shoulder levels, symmetry of head, chest, hips and lateral view for head position, prominence of spine and Adam's forward bending test was performed for rib and flank prominence and if visible curvature was seen, palpatory method was used for palpation of spinous processes for structural scoliosis in thoracic and thoraco-lumbar region which was from

PSIS → S2 (2nd Sacral Vertebrae) → L5 → to above Upwards

Functional scoliosis was when visible curvature was seen only on forward bending and disappeared on extension (standing position)and structural scoliosis was when curvature was present in both forward bending and extension.

Result

Of the 30 subjects initially enrolled in the study, 19 of them with scoliosis and 11 of them with no features or characteristics of scoliosis. Of 19 subjects 10 with structural scoliosis group and 9 with functional scoliosis group completed assessment and both testing sessions.

Children assessed were classified according to their gross motor functional level based on their level participation in functional activities of daily living.

The above shows gender and GMFCS levels of children assessed which states that number of boys and girls which are present in a particular GMFCS level (Figure 1).

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Table 1.Descriptive Statistics. values Represent Mean (Sd), Unless Indicated Otherwise

Description	Functional Scoliosis N=9	Structural Scoliosis N=10
Age (Y)	9.555555556	9.4
Male-Female Ratio (N)	06:03	08:02
GMFCS Level	2.25	2.5
CP Subtype	1.8	2
Scoliosis Appearance Questionnaire	36.4	35.1
Self Made Questionnaire	112.44	112.9
Age at CP Diagnosis	1.6	1.5

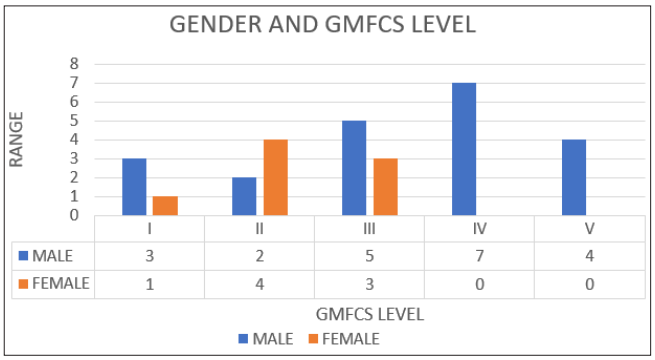

Figure 1.Gender and GMFCS level

In thoracic scoliosis, rib prominence to right side was 33% and to left side was 27% and there was no evidence of rib prominence in 5 % of the cases. In thoraco-lumbar scoliosis, rib prominence to right side was 37% and to left side was 19% and there was no evidence of rib prominence in 9% of the cases.

The above statement means that rib prominence to right side was more in both thoracic and thoraco-lumbar scoliosis (Figure 2).

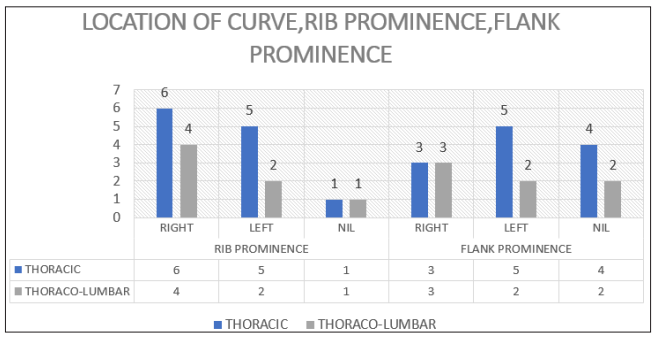

Figure 2.Relationship between location of curve rib and flank prominence

In thoracic scoliosis, flank prominence to right side was 16% and to left side was 27% and there was no evidence of flank prominence in 22% of the cases. In thoraco-lumbar scoliosis, flank prominence to right side was 28% and to left side was 19% and there was no evidence of flank prominence in 19% of the cases.

Out of 30 children assessed 19 of them had shown characteristics of scoliosis. Incidence of scoliosis at thoracic region was 50% both for structural scoliosis and functional scoliosis. Whereas at the Thoraco-lumbar region incidence of scoliosis was 70% for structural scoliosis and 30% for functional scoliosis which means that incidence of structural scoliosis at thoraco-lumbar region was more than functional scoliosis (Figure 3).

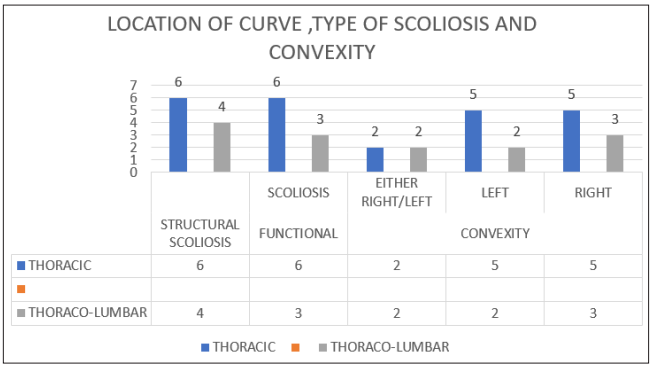

Figure 3.Relationship between location of curve, type of scoliosis and convexity

In thoracic region convexity to both left and right side of the body was found in equal amounts i.e., 27% to the left side of the body and 27% to the right side of the body.

However, in functional scoliosis there may be shift of the curve either to right side or left side of the body as a compensatory, postural adjustments of the spine in response to surrounding environmental demand. Incidence in thoracic region for convexity either to left or right side of the body was 11% and in thoraco-lumbar region was also 19%.

In thoraco-lumbar region convexity to left side of the body was 19% and convexity to the right side of the body was 28%.

The above shows the various sub-types of cerebral palsy children found in the population of 05-20 years and incidence rate of scoliosis in a particular sub-type of cerebral palsy (Figure 4).

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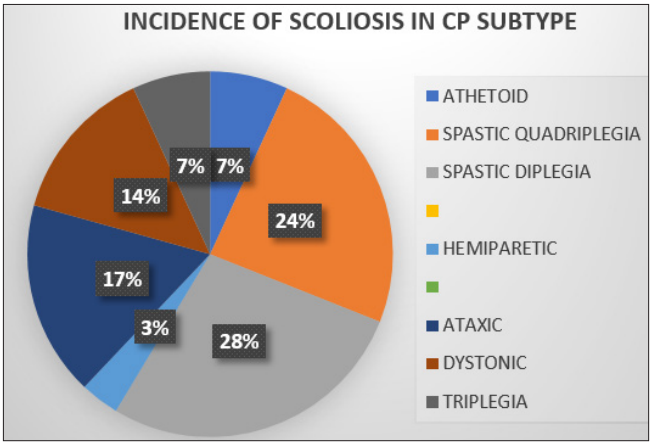


Figure 4.Types of cerebral palsy

Scoliosis was divided into mild, moderate and severe with respect to degree of extent of lateral curvature of spine. Mild scoliosis means a discrete curve visible only during forward bending. Moderate scoliosis means a lateral curvature visible during both standing and forward bending positions. Severe scoliosis means an obvious visible curve which prevented the child from attaining an upright position without an external support

The scoliosis appearance questionnaire was a 50-marker scale and majority 22 out of 30 children (Figure 5) had a score range between 30-40 which suggest moderate severity of scoliosis.

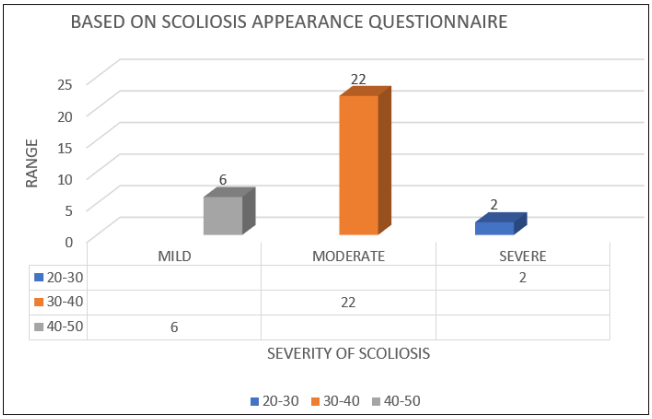


Figure 5.Classification of scoliosis into mild, moderate, severe based upon scoliosis appearance questionnaire

The above shows level of difficulty faced in activities of daily living and in positioning, transfers and mobility and level of assistance provided or given to these children in achieving or coping up with these ADL'S and positioning transfers and mobility.

More is the score which means less was the difficulty faced which further means less was the assistance given.

The total score for level of difficulty in ADL'S was out of 30 and level of assistance in ADL'S was out of 15. The total score for level of difficulty in positioning, transfers and mobility was out of 36 and level of assistance was out of 24.

The level of difficulty was divided into very difficult, difficult, easy, very easy and almost impossible to do that activity. The level of assistance provided was divided into moderate, minimal supervised, dependent. The above (Figure 7) show that less score which means more was the difficulty, more is the score for assistance and vice versa.

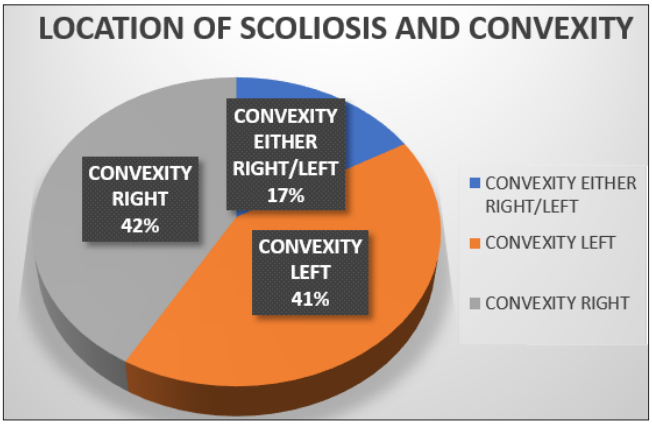
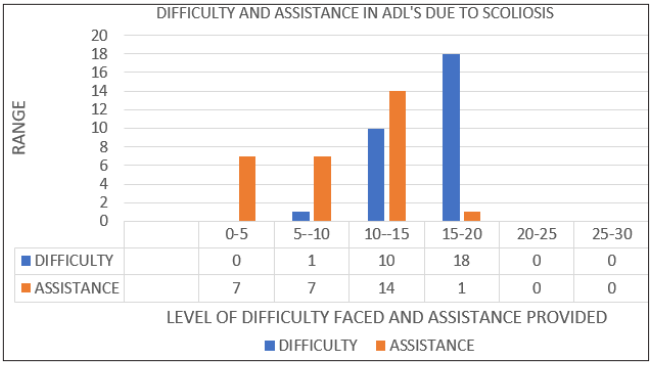


Figure 6.Incidence rates of convexities



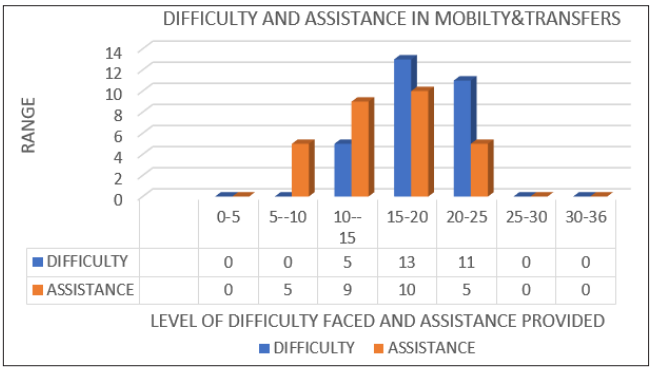


Figure 7.Activities of daily living and tranfers

The above (Figure 8) shows comparison between health status and quality of life.

Most of the caregivers/ parents of the child reported fair both in terms of quality of Health and quality of life. The health status is directly proportional to quality of life which means that better the Health of the child better is the quality of life experienced by the child.

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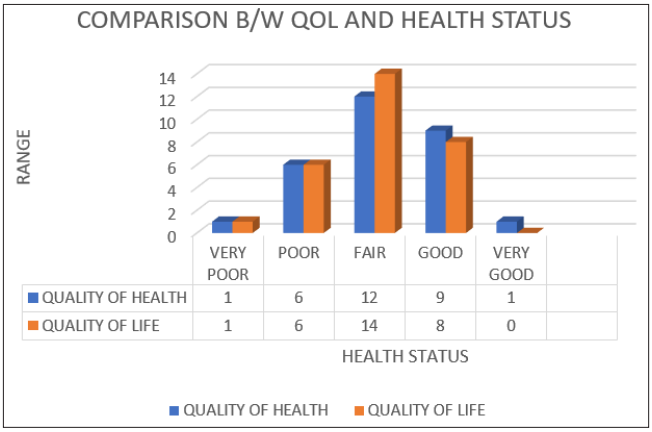

Figure 8.Comparison between health status and quality of life

Figure 9.Subjects showing visible lateral curvatures

Discussion

The purpose of this research was to analyse scoliosis among different sub-types of cerebral palsy children and their association with Gender, GMFCS level, type of scoliosis dominant in cerebral palsy and location of curve.

Age of the study participants was ranging from 05 to 20 years. Study has witnessed a greater number of male participants 33% belonging to GMFCS level IV and 19% belonging to GMFCS level V (Figure 1) compared to females found in GMFCS level II and III which was similar to the findings by Gunnar hagglund and kattina petterson et al. (2018) in which incidence of scoliosis was related to age and gender.[3]

Amongst the children assessed, majority of them were spastic CP, in which incidence of scoliosis was 28% for spastic diplegia and 24% for spastic quadriplegia (Figure 4). Incidence of scoliosis was greater in spastic quadriplegia mostly belonging to GMFCS Level V followed by spastic diplegia, ataxic and dystonic. However, incidence was less among hemiparetic CP (3%) These findings are in line with existing literature by N Saito, S Ebara et al. where risk factors for progression of scoliosis in spastic cerebral palsy are: having a spinal curve of 40° before age 15 years; having total body involvement; being bedridden; and having a thoracolumbar curve.[9]

Majority, 22% children were found having moderate scoliosis within range of 30-40 out of total score of 50 and only 6% of them were found having mild scoliosis. However only 2% of them showed having severe scoliosis in CP. (Figure 5). Though contrary results obtained in a study by Gunnar hagglund and kattina petterson et al, (2018) showing scoliosis was graded as moderate in 48 cases (26 males, 22 females) and severe for 92 (50 males, 42 females).[3]

In thoracic region structural scoliosis was found in equal amounts i.e., 27% to the left side of the body and 27% to the right side of the body and for thoraco-lumbar region structural scoliosis with convexity to right (28%) was more as compared to left side(19%) Functional scoliosis (convexity either to left or right side of the body) was more in thoraco-lumbar region (19%) compared to thoracic(11%) which is in line with the existing literature by Lonstein JE, Akbarnia A in which 107 cerebral palsy patients with scoliosis 44 of them had Group I curve (with a thoracic component) (double balanced curve)63 patients had Group-II curves were large unbalanced lumbar or thoraco-lumbar curves.[9]

Majority of children with cerebral palsy non operated for scoliosis showed moderate discomfort (76%); 17% showed mild discomfort while 7% showed severe discomfort during ADL'S and positioning, transfers and mobility. (Figure 7) which is in partial agreement to the study done by Sewell, Mathew D; Malagelada, Francesc; Wallace et al., which states that nonoperative treatment for children with GMFCS level IV/V CP and a significant scoliosis was associated with a small decrease in carer-assessed QoL during childhood and Spinal fusion was associated with an increase in QoL but Surgery did not improve mobility.[10]

Majority, 72% of them showed a fair communication and interaction in terms of understanding mother, communication with family members and other people, playing attending school/ child care, However, majority of them showed difficulty in attending school, playing and participation in recreational activity (less was the score more was the difficulty)which is contrary to Study done by Sewell, Mathew D; Malagelada, Francesc; Wallace et al, which states that there is no correlation for non-surgical group between CPCHILD QOL questionnaire score and communication.[10]

Conclusion

Cerebral palsy was most commonly found in males and most were found in GMFCS level 5 because these are almost preterm male and studies have shown that they also appear to be more vulnerable to white matter injury and intraventricular haemorrhage than females. Spastic quadriplegia is the most common type of cerebral palsy as it can be caused by a condition known as periventricular leukomalacia which results in the formation of lesions

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and holes in the white matter of the brain is especially vulnerable between the 26th and 34th weeks of maturation, and damage to the white matter can interfere with the brain's ability to transmit signals to the rest of the body. Moderate scoliosis was found because Progression of curve is expected to continue until skeletal maturity is reached and many children were found in risk of scoliosis and increased chances of progression of curve till skeletal maturity.

Structural scoliosis is more common because of the prolonged effects of immobilization due to recumbency in wheel chair or in supine position and muscular imbalance between agonist and antagonist of trunk musculature and effects of gravity on these muscles and also owing to muscle spasticity and tightness. Rib prominence to right side was more MAY BE due to increased convexity of curve to right side causing the ribs to sticking out to same side of the body and also elevation of right shoulder was found to be more in individuals. Children had difficulty in communication as speech was either delayed or incomprehensible and there was no use of disyllables. Most sought the use of non-verbal speech and expressing through emotions. Most parents thought neither too good nor too bad will be their child's quality of life in terms of future endeavours without their presence. Majority of children were unable to maintain balance of trunk or upright position while eating or being fed and upper body dressing and also to maintain supported sitting posture.

Limitations of the Study

- Exposure of back was not possible in Females of age group of more than 15 years due to puberty and adolescence issues.
- Spastic quadriplegia CP children who are either wheel chair bound, were unable to bend forward or perform Adam's forward bending test. Alternate position of all fours position was obtained in such patients.
- CP child unable to comprehend or follow instructions or commands.

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Conflict of Interest: None

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