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CAN EARLY ORTHOTIC SUPPORT AND PHYSICAL THERAPY IMPROVE THE FUNCTIONAL LEVEL AND DECREASE RATE OF SURGICAL INTERVENTIONS IN SPASTIC CEREBRAL PALSY?

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ABSTRACT:

OBJECTIVE: cerebral palsy is a disorder of movement and posture that results from a non progressive lesion of brain within 3 years of age. To determine the role of early orthotics and physical therapy in improving the functional status and in decreasing the rate of surgical interventions in management of spastic diplegic cerebral palsy child.

STUDY DESIGN: Interventional study design

Place and Duration of Study: The department of Physical Medicine & rehabilitation (PM&R) of the Children's hospital & ICH Lahore from Nov 2017 to Oct 2018.

METHODOLOGY: In this study fifty patients of spastic diplegic cerebral palsy with age between 1 to 7 years having spasticity since birth and have achieved supported sitting were studied. The cerebral palsy children having history of global developmental delay, more than 07 years old, head injury, h/o seizures, ataxic cerebral palsy and spastic quadriplegic cerebral palsy were not included in this study. The data was taken by consecutive sampling technique. Study sample was completed in first month of our study. Diagnosed children with spastic diplegic cerebral palsy were included. Their spasticity level was checked by using Modified Ashworth scale (Level 0 to 4) and their functional level was assessed by Gross motor functional classification scale (Level 1 to 5). These children were given a rehabilitation programme and different orthotics were recommended where needed. After six months of physical therapy sessions, patients whose spasticity level was 03 or more on Modified Ashworth's scale were referred for surgical opinion.

RESULTS: It was seen in our study that the patient who came early in our department (2-5 years) with better initial functional level (Level II - III) showed marked improvement in 28 (88%) and who presented late (5-7years) with poor initial functional level (Level IV- V) showed less improvement in 07 patients (38%). These difference between initial presenting functional level was found to be statistically significant over the final functional level and improvement ($P < 0.05$).

The rate of surgical interventions in patients who presented at age 2 to 5 years, and started physical therapy earlier, was less i.e. (4%) and in those patients who presented at age 5 to 7 years with more initial spasticity level and multiple contractures, was high i.e. (26%). The difference of surgical procedures in patients presenting early in our department with good initial presenting functional level to patients presented in later stages with poor initial functional level was found to be statistically significant ($P < 0.05$).

CONCLUSION: Early orthotic support and physical therapy treatment improve the functional level of ambulation and decreases the rate of surgical interventions in management of spastic diplegic cerebral palsy child.

KEYWORDS: Cerebral palsy, diplegic, Ambulation dysfunction, Orthotics, Physical therapy.

INTRODUCTION:

Cerebral palsy is a disorder of movement and posture resulting from non progressive lesion or injury of brain¹ within 3 years of age resulting in heterogeneous spectrum of clinical syndrome characterized by alteration in muscle tone, deep tendon reflexes, primitive reflexes and postural reactions². Recent studies showed that there may be other associated problems such as mental retardation, seizures disorder, visual & hearing problems^{3, 4}. The incidence of cerebral palsy is about 2-3/1000 live births in united state^{5, 6}. Aetiology of cerebral palsy including vascular, genetic, metabolic, traumatic and primary neurological causes. It is associated with abnormalities of pregnancy and birth. The most common causes of diplegic CP are birth asphyxia and low birth weight⁷. The brain injury in cerebral palsy may occur during prenatal, perinatal and postnatal period. On examination, these children reveal spasticity in legs, brisk reflexes, ankle clonus and bilateral babinski sign was positive. These children showed marked ambulation dysfunction and usually keep the foot in equinovarus position and walk on toes⁸. There is no sensory loss in cerebral palsy. In cerebral palsy, early physiotherapy treatment and use of orthotics are very helpful in promoting normal motor development⁹, prevention of contracture formation and deformities. Physiotherapy treatment including stretching exercises of tight structures, strengthening of weak muscles, exercise on medicine ball for trunk control, balance training, gait training and use of orthotics mainly AFO, walkers, parallel bars, tilt tables are used in rehabilitation training¹⁰. Early diagnosis, regular physical therapy session with regular follow-up and with help of appropriate orthosis, we can achieve good results than in neglected child with more spasticity and fixed contractures.^{11, 12, 13}

SUBJECT AND METHODS:

This study was conducted at The department of Physical Medicine & rehabilitation (PM&R) in The Children Hospital & ICH Lahore over a period of twelve months from Nov. 2017 to Oct 2018. Informed consent was taken from parents or attendants to take data for research purpose after taking informed consent and approval from ethical committee. In this study, fifty patients of diplegic cerebral palsy with age between 1 to 7 years having spasticity since birth and have achieved supported sitting were studied. The cerebral palsy children having history of global developmental delay, more than 07 years old, head injury, h/o seizures, ataxic cerebral palsy and spastic quadriplegic cerebral palsy were not included in this study. The data was taken by consecutive sampling

technique. These patients were diagnosed by taking detailed history including prenatal, perinatal and postnatal events and sensory motor developmental milestones. on clinical examination, evaluation of CNS examination, musculoskeletal examination and gait analysis was done, spasticity was checked by using Modified Ashworth scale and their functional level was categorized from I to V by using Gross Motor functional classification Scale. These patients were given a rehabilitation programme including passive range of motion (P-ROM), active range of motion (A-ROM), manual stretching of tight structures, self stretching techniques, strengthening exercises of weak muscles, use of tilt tables and CP chair, gymnasium ball, wedge boards, vestibulator for balance training, gait training in parallel bars, hydrotherapy, Bobath and NDTs and different orthotics and medication to decrease spasticity according to the need were recommended. These patients were given therapy sessions twice per week. These patients were on monthly follow up to access the ambulatory status. After six months of physical therapy sessions, patients whose spasticity level was 03 or more on Modified Ashworth's scale were referred for surgical opinion. Surgical intervention was done in 15 (30%) patients. Adductor tenotomy was done in 2 (4%) patients and hamstring release with tendoachilles lengthening in 3 (6%) and tendoachilles lengthening alone in 10 (20%) patients. Surgical procedures were done in orthopaedic department of The Children's hospital and they were given pre and post operational surgical rehabilitation plans. At twelve month of therapy treatment and use of orthotics, final assessment was done by using Modified Ashworth scale and Gross Motor Functional classification Scale.^{14, 15} All analysis was performed using SPSS version 24. Quantitative data such as age was calculated by using mean and standard deviation. Data including causes, deformities, surgical interventions, reduction in spasticity and improvement in functional level was calculated by using frequency and percentages. Variables like reduction in spasticity, use of lower limb braces, surgical interventions and improvement in functional level was analysed by chi square test. P value < 0.05 was taken as significant statistically.

Table 1: Modified Ashworth Scale (MAS) 16

Grade	Description
0	No increase in muscle tone
1	Slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the range of motion when the affected part(s) is moved in flexion or extension
1+	Slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the ROM
2	More marked increase in muscle tone through most of the ROM, but affected part(s) easily moved
3	Considerable increase in muscle tone, passive movement difficult
4	Affected part(s) rigid in flexion or extension

Table 2: Gross Motor Functional Classification Scale (GMFCS) 17

Level – I	Walks without restrictions: limitations in more advanced gross motor skills
Level – II	Walks without assistive devices: limitation in walking outdoors and in the community.
Level – III	Walks with assistive mobility devices: limitation in walking outdoor and in the community.
Level – IV	Self mobility with limitations: children are transported or use power mobility outdoor and in the community.
Level – V	Self mobility is severely limited even with the used of assistive technology.

Results:

Table 3: Distribution of cases by level of spasticity

Initial Spasticity level	Initial No of patients (F)	Final Spasticity level in Modified Ashworth's scale				Improved Patients (f)	Not Improved Patients (f)
		1+	2	3	4		
Modified Ashworth's scale							
2	26	22	4	0	0	22(44.2%)	4(8%)
3	15	0	10	5	0	10(20%)	5(10%)
4	09	0	0	6	3	6(12%)	3 (6%)
Total	50	22	14	11	3	38 (76%)	12 (24%)

P<0.05

Table 4: Distribution of cases by level of improvement

Initial Functional Independent Measure	Initial No of patients	Gross Motor Functional Classification Scale (GMFCS)					Improved Patients (f)	Not Improved Patients (f)
		1	2	3	4	5		
GMFCS level								
2	6	5	1	0	0	0	5(14.2%)	1(6.6%)
3	26	0	23	3	0	0	23 (62.8%)	3(20%)
4	12	0	0	5	7	0	5 (15%)	7 (46%)
5	6	0	0	0	2	4	2 (5.7%)	4 (26.6%)
Total	50	5	24	8	9	4	35 (70%)	15 (30%)

P<0.05

Table 5: Use of orthotics and surgical procedure

Type of orthotic used and surgical procedure		F	Percentage
Orthotic	AFO	24	48%
	KAFO	5	10%
Walkers	Posterior walker	12	24%
	Front wheel walker	20	40%
	Adductor tenotomy	2	4%
Surgical procedure	Hamstring release with tendoachilles lengthening	3	6%
	Tendoachilles lengthening	10	20%

Table 6: Distribution of cases by surgical intervention

Age	Initial presenting Level (GMFCS)	Frequency	Improved Patients	Surgical intervention in improved Patients	Surgical intervention in non improved Patients	Total no. of surgical intervention
2-5 years	Level 2-3	32	28(88%)	1	1	2 (4%)
5-7 years	Level 4-5	18	7(38%)	5	8	13(26%)

P<0.05

In this twelve months study periods 50 patients of diplegic cerebral palsy with mean age of 3.7 years were included. History of birth asphyxia was present in 24 (48%) while prematurity was present in 19 (38%) of cases and full term SVD with unknown cause was seen in 7(14%) patients. Most common deformity was ankle equinovarus in 24 (48%) and scissoring in 10 (20%) cases. In our study lower extremity orthotics were used in 29 (60%) of children with AFO being most commonly used in 24 (48%) of cases and KAFO in 5 (10%). Paediatric walker with front wheel was the most commonly used assistive mobility device in 20 (40%) patients and posterior walkers in 12 (24%). Surgical intervention was done in 15 (30%) patients. Adductor tenotomy was done in 2 (4%) patients and hamstring release with tendoachilles lengthening in 3 (6%) and tendoachilles lengthening alone in 10 (20%) patients. At last follow up patient showed marked reduction in hypertonicity. Results of our study showed that 38(76%) showed reduction in hypertonicity and 12 (24%) did not show reduction in their initial presenting hypertonicity status. Out of fifty diplegic CP children, at initial presentation according to Modified Ashworth's scale, 26 (25%) patients were in grade 2, 15 (30%) were in grade 3 and 09 (18%) were in grade 4. At last follow up, only 03 (6%) were in grade 4, 11 (22%) were in grade 3 and 14 (28%) were in grade 2 and 22 (44%) were in grade 1+. These difference between initial presenting hypertonicity level was found to be statistically significant over the final hypertonicity level and improvement (P<0.05).

Follow up was done every month and on last follow up the patient showed marked improvement in functional

ambulatory status. Results of our study showed that 35 (70%) of our children improved one level higher than their initial presented level, 15 (30%) showed no improvement in 12 months study periods. Out of 35 (70%) improved patients, 02 patients (5.7%) improved from level (V to IV), 05 (15%) improved from (Level IV to III), 22 (62.8%) from (Level III to II), 05 (14%) improved from (Level II to I) and 15 patients (30%) showed no improvement in their functional status. This difference between good initial level and improvement was found to be statistically significant over the poorer initial level and improvement ($P < 0.05$).

The rate of surgical interventions in patients who presented at age 2 to 5 years, and started physical therapy earlier, was less i.e. (4%) and in those patients who presented at age 5 to 7 years with more spasticity and contractures, was high i.e. (26%). The difference of surgical procedures in patients presenting early in our department with good initial presenting level to patients presented in later stages with poor initial functional level is statistically significant ($P < 0.05$).

Discussion:

In this 12 months study, 50 patient of Diplegic CP were included and were given physiotherapy treatment, orthotics were recommended where needed, the patients who did not show improvement up to 06 months after physical therapy and according to Modified Ashworth's scale, hypertonicity level was 03 were referred for surgical opinion. It is proved that the best age to perform surgery varies with patient and his problem but almost the best time for surgery is at age of 4 or 5 years but before age of 8 years.¹⁸

The patients who came in our department earlier (2-5 years), with better initial functional level (II to III), they showed marked improvement (88%) as compared to patients who came later (5-7 years) with poor initial functional level (IV-V), in them recovery level was poor 38%. An association was found between good initial functional level and improvement ($p < 0.05$). These results match to the Canadian study which shows that marked improvement of motor function at early age until around 05 years and decrease in walking ability with increase of age.

Surgical interventions in patients coming early in our department was less 4% as compared to patients who came later at age of 5-7 years, in them the rate of surgical intervention was high 26%. The difference of surgical procedures in patients presenting early in our department with good initial presenting level to patients presented in later stages with poor initial functional level was statistically significant ($P < 0.05$)

The delayed referral for rehabilitation (after 2 years of

age) was possibly due to lack of early detection of cerebral palsy in these children and non availability of a few special centers for pediatric rehabilitation in Pakistan.

Use of orthotics is an integral part of management of cerebral palsy.¹⁹ The most commonly used orthotic was AFO in 24 (48%) and KAFO in 05 (10%) and walkers in 32 (64%). AFOs were adjusted to control position of the ground reaction force in relation to knee. Use of AFO resulting in marked improvement in foot-ground contact and stance-phase posture in children with spastic diplegia. Surgical procedures including adductor tenotomy was done in 02 (04%), hamstring release with tendoachilles lengthening in 03 (6%) and tendoachilles lengthening alone in 10 (20%). Patients were given post operative rehabilitation plan. A study conducted on the role of orthopedic surgery in the treatment of spastic patients. They found that operative treatment followed by physical therapy has significant role in improving ambulation.²⁰

There were some limitations in our study including delayed diagnosis even above age of 07 years, irregularity in follow up in outstation patients. In relation to spasticity, use of injection Botox was not applied due to non availability in Govt. Hospital and non affordability of patients.

We think that posterior rhizotomy may be used in treatment of spasticity, which is not available in Punjab. So with early diagnosis²¹, physical therapy and use of orthosis, can improve the functional level and ultimately improve the quality of life of cerebral palsy patients.

Conclusion:

In the management of diplegic CP, with early and accurate diagnosis, physical therapy treatment & use of orthotics, we can get good results in reducing spasticity and decreasing the rate of complications including the contracture formation and ultimately reducing the rate of surgical interventions with improving functional level.

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Author's contribution:

Sarfaraz ahmad; concept, data collection, data analysis, manuscript writing, manuscript review

Syeda rahat; data collection, data analysis, manuscript writing, manuscript review

Syeda Bushra;data collection, data analysis, manuscript writing, manuscript review