Original Research Article

Evaluation of Hand function in patients of Cerebral Palsy: A prospective study from North India

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Abstract

Introduction: It has been shown that 10% of the global population suffers from some sort of disability due to various reasons; in India, this figure is 3.8 percent of the population. Cerebral Palsy affects approximately 15-20% of physically challenged children. In India, the incidence is estimated to be around 3/1000 live births. The most prevalent motor disability in children is cerebral palsy. Monoplegia, hemiplegia, diplegia, and quadriplegia are the topographic classifications for CP; monoplegia and triplegia are relatively uncommon. Diplegia is the most prevalent type, accounting for 30 percent to 40 percent of all cases. The most prevalent type of CP is spastic CP, which accounts for 70 percent to 75 percent of all cases. Cerebral palsy affects hand function, however it has been studied very rarely and there is very little data on hand function in different types of cerebral palsy. **Objectives:** To describe characteristics of hand function in cerebral palsy children. **Methods**: This prospective study was conducted on 100 children of cerebral palsy who came to the department of Physical Medicine and Rehabilitation, Government medical college patiala from Aug 2021 to Oct 2021. Upper extremity data were collected from the 100 children of cerebral palsy. Hand function was classified according to the Manual Ability Classification System(MACS) and House functional classification system. **Results**: In the overall group of Cerebral Palsy children aged >5 to <14 years, 81 percent reported more than modest hand function deficits (>MACS 1). We discovered that 23% of children with MACS 5 had substantial limitations in hand function. Only 19% of children were classed as MACS1 because they were unable to handle objects effortlessly and successfully. According to the house functional classification, 46 percent of children (house 7-8) used both hands spontaneously and independently, while 7 percent did not use either hand (House 0) **Conclusion**: Hand function deficits are evident in all types of CP, however the characteristics of the disability differ greatly. The MACS classification can be used to determine how well children handle situations in everyday life. The grip function in each hand is depicted separately in the House functional classification. Although additional research into the psychometric aspects of these classifications is needed, they have all been demonstrated to be effective in a population-based health-care strategy.

Keywords: Hand function, Cerebral Palsy, Manual ability classification system

Introduction

According to statistics, ten percent of the global population is disabled for various reasons; in India, this proportion is 3.8 percent of the population. Around 15-20% of physically challenged children have Cerebral Palsy. The rate is predicted to be around 3/1000 live births in India[1]. The ability of the hands to function successfully in a range of conditions is dependent on the integrity of the central nervous system, which can be disturbed by a variety of brain illnesses. Cerebral palsy (CP) is the most prevalent physical disability in children[2].

Arm–hand disability affects about half of all children with cerebral palsy[3,4]. Children with unilateral spastic CP rarely use their paretic hand in daily activities[3,5]. As a result, hand function in children with CP has received greater attention in the last decade.

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The International Classification of Functioning, Disability, and Health (ICF) theoretical framework can be used to define the impact of CP on a child's hand functioning[6]. According to the ICF, CP can affect three domains of functioning: physical functions and structures (body domain), actions (person domain), and involvement (participation domain) (social domain). Because the social component cannot be reduced to the single function of the hands, this study solely looked at the body and individual domains. Body functions refer to the physiological and psychological functions of the various bodily systems. Body structures relate to the anatomical parts of the body.

Early brain traumas that impair the corticospinal tract are the cause of CP. CP can impair the hand and its components (e.g., muscles, joints, and bones), as well as numerous body processes (e.g., muscle strength, control of rapid coordinated movements, touch-pressure detection, and recognition of common objects and shapes). CP may also limit the ICF sphere of activities, which refers to the ability to perform a basic job or daily action (e.g., eating, drink- ing, grooming, or dressing). In this article, "hand skills" refers to hand functions (ICF body domain) and hand mobility.

Manual ability (MA) refers to a child's ability to manage daily activities that require the use of hands and upper limbs (ICF activity domain, self-care subdomain)[7].

Cerebral palsy is the musculoskeletal manifestation of a prenatal brain trauma-induced non-progressive central nervous system lesion. Despite the fact that the brain injury is stable, the musculoskeletal disease is advancing. Spasticity shortens the musculoskeletal units, resulting in persistent contractures, long-bone torsional abnormalities,

joint instability, deformity, and degenerative arthritis[8]. The clinical manifestation might range from a bright youngster with mild hand stiffness to a wheelchair-bound child who is unable to talk and ignores his or her affected upper limb totally.

All patients, however, share the following characteristics[9]:

- A brain injury causes cerebral palsy. As a result, the spinal cord and muscles structure and biochemistry are both normal.
- The brain lesion must be stable and non-progressive. As a result, all progressive neurodegenerative diseases are excluded from the definition.
- A brain disorder causes motor disability.

The complexity of the spastic hand derives from the fact that spastic muscles cannot be used as tendon transfers as well as they can be in reconstructive surgery for the flaccid paralysed hand[10].

The goal of this study was to describe various aspects of hand function in people with cerebral palsy.

Methodology

This study was performed in the department of Physical Medicine and Rehabilitation at Government Medical College Patiala. We conducted this study from Aug 2021 to Oct 2021 after taking permission from the institute ethics Committee and research review board. This is a prospective observational hospital based study performed on patients with cerebral palsy.

Inclusion criteria

1. Patients age > 5yrs & < 14 yrs
2. Children with no major intellectual deficit
3. Willing to participate in the study

Exclusion criteria

1. Uncontrolled seizures
2. Botulinum toxin injection or orthopaedic surgery in the upper extremities
3. Visual problems that can interfere with examination

The CP subtypes[11] were determined according to the clinical features into Spastic, Ataxic and Dyskinetic further spastic cerebral palsy is divided into spastic hemiplegia, spastic quadriplegia and spastic diplegia and dyskinetic cerebral palsy is divided into athetoid and dystonic.

Assessment of Hand Function

The children were evaluated by Physical Medicine and Rehabilitation expert for assessment following scales were used: Manual ability classification system(MACS)[12] and House functional classification system[13].

MACS: The MACS Table 1 class 1 assigns a five-level rating to a child's ability to handle objects in daily activities (www.MACS.nu). Level I denotes the highest level of manual competence, while level V denotes the lowest. The child's regular performance is classified, not his or her maximum capacity. The level is assessed by interviewing a friend or family member about the child's regular performance and need for assistance handling objects. The MACS does not attempt to discern between the two hands' capacities. It is suitable for children aged 4 to 18.

Table 1: MACS classification

MACS Level	Description
I	Handles objects easily and successfully
II	Handles most objects but with somewhat reduced quality or speed of achievement
III	Handles objects with difficulty; needs help to prepare or modify activities
IV	Handles a limited selection of easily managed objects in adapted situations
V	Does not handle objects and has severely limited ability to perform even simple actions

The House functional classification (Table 2) was created to assess function in the affected hand following surgery to correct a thumb-in-palm deformity in infants with spastic hemiplegic CP.18 The classification was employed in this study for each hand independently in all forms of CP. There are nine classes in the classification, ranging from not being used at all (grade 0) to being used spontaneously and independently from the other hand (grade 1). (grade 8). The evaluation in this study was done by watching the child do activities that required bimanual hand function.

The amount of function in each hand was first determined—no use (0), passive assist (1–3), active assist (4–6), or spontaneous use (7–8)—and then an attempt was made to partition into the 9 functional groups 0–8. Level 8 was regarded as a normal hand that could be utilised independently of the other.

Table 2: The House functional classification

Grade	Designation	Activity Level
0	Does not use	Does not use
1	Poor passive assist	Uses as stabilising weight only
2	Fair passive assist	Can hold on to object placed in hand
3	Good passive assist	Can hold on to object and stablize it for use by the other hand
4	Poor active assist	Can actively grasp object and hold it weakly
5	Fair active assist	Can actively grasp object and stabilises it well
6	Good active assist	Can actively grasp object and then manipulate it against other hand
7.	Spontaneous use, partial	Can perform biannual activities easily and occasionally uses the hand spontaneously
8.	Spontaneous use, complete	Uses hand completely independently without reference to the other hand

Patient aged >5yrs to <14yrs were included in the study, who were attending the Department of physical Medicine and Rehabilitation.

All children with cerebral palsy were assessed using the above scales and informed about the study's kind and purpose. Patients parents gave the informed consent for the participation in the study and were involved in the study.

Results

A total of 100 diagnosed cases of different CP subtypes aged >5yrs to <14yrs attending the department of physical medicine and rehabilitation were enrolled in the study.Distribution of different CP subtypes according to clinical subtypes is shown in Table 3.

Table 3: Distribution of cerebral palsy subtypes

CP type	Subtype	Number of children	Percentage
Spastic	Hemiplegia	21	21
	Quadriplegia	5	5

	Diplegia	57	57
Ataxic	Ataxic	6	6
Dyskinetic	Athetoid	6	6
	Dystonic	5	5

MACS

Distribution between MACS levels in the total patients is shown in Table 4.

Out of 100 children, 48 (48%) were self-sufficient in age-appropriate manual activities (MACS I and II), whereas 23 (23%) had no active hand function and were completely reliant on others for their daily needs (MACS V).

We discovered that children with spastic hemiplegia had 16 out of 21 (76 percent) MACS I and II subtypes of CP. MACS I and II were found in 27 of the 57 children with spastic diplegia (47 percent). MACS IV and V were found in 4 out of 5 (80%) children with quadriplegic CP and 12 out of 17 (70%) children with ataxic and dyskinetic CP.

Table 4: Distribution of MACS levels in different Cerebral Palsy subtypes

CP subtype	MACS I	MACS II	MACS III	MACS IV	MACS V	Total CP patient
Spastic hemiplegia	7	9	1	2	2	21
Spastic quadriplegia	0	0	1	1	3	5
Spastic Diplegia	11	16	15	6	9	57
Ataxic	1	1	1	1	2	6
Dyskinetic	0	1	1	2	7	11

The house functional classification

Table 5 shows hand function in children with various CP subtypes according to House. In 11 children with spastic hemiplegic CP (n 21), both hands were rated as House 7 or 8. (52 percent). In spastic diplegia CP, the equivalent percentage was 45 percent (26 of 57 children). Spastic diplegia (3), spastic quadriplegia (2), dyskinetic CP (1), and ataxic CP were identified in the 7 children who had complete non-use of both hands (House 0).

Table 5: Distribution of Function according to house in different Cerebral Palsy

CP subtype	Dominant(D)/ Non Dominent(ND)	House 0	House 1-3	House 4-6	House 7-8	Total CP patient
Spastic hemiplegia	**D**	0	0	6	15	21
	ND	0	3	7	11	21
Spastic quadriplegia	**D**	2	3	0	0	5
	ND	3	2	0	0	5
Spastic Diplegia	**D**	3	8	15	31	57
	ND	4	11	16	26	57
Ataxic	**D**	1	3	2	0	6
	ND	1	4	1	0	6
Dyskinetic	**D**	1	4	6	0	11
	ND	1	6	4	0	11
Total	**D**	7	18	29	46	100
	ND	9	26	28	37	100

Discussion

To describe hand function in cerebral palsy children, we employed MACS and The House functional classification system. It is critical to have good hand function in order to be independent in daily tasks. Hand function is hampered in cerebral palsy due to an increase or variation in muscular tone, which produces imbalance and sometimes contractures. Many innovative treatments, such as newer pharmacotherapies for decreasing spasticity, surgical muscle tendon lengthening and transfer, and botulinum toxin in afflicted muscles, are now being employed in the therapy of hand function. We can prevent contractures by using these procedures, which is now more feasible. However, identifying early difficulties with hand function is crucial for treatment planning.

Hand function is a multidimensional entity with many various components, including gripping and releasing items, reaching, speed and accuracy, grip strength, and so on. Cognition is also a required and integral component of normal hand function. According to research conducted by Nordmark E et. Al.[14] and Beckung E et. Al.[15], 50-70 percent of children with cerebral palsy have subnormal cognitive abilities. However, we attempted to eliminate these children from our study and only included children with normal cognition. There is no one examination that can evaluate hand function in children with cerebral palsy because it is a complex condition that necessitates the use of multiple scales.

MACS was employed as a starting point for determining the level of hand function. This is a categorization that was created by an international work group and has proven to be reliable and valid in the past. One of mACS's significant flaws was that it couldn't tell the difference between various capabilities in the two hands.We also employed The House functional classification, a nine-level functional categorization devised by House et al. in our research. This categorization is most commonly used to assess the injured hand prior to and after surgery. Many prior research, such as Marianne Arner et al.[13], used this classification to assess hand function. This categorization was used to assess each hand individually in children with various kinds of unilateral or bilateral cerebral palsy.In our study we evaluated 100 children with cerebral palsy of different types of CP, we found > 80% of the cerebral palsy children having more than minor problems with hand function (MACS>1).we found that most severely affected hand function was in dyskinetic cerebral palsy with 7/11 patients were in (MACS V). The most common form of cerebral palsy i.e spastic diplegia most of the patients 54% patients were in (MACS II&III). In children with spastic quadriplegia cerebral palsy we found all patients (MACS>II). Whereas in spastic hemiplegic about 76% were considered to be independent in age appropriate manual activities with (MACS I &II).

We found that the quadriplegic CP had severe hand problems with 60% children having MACS V and 60% had at least 1 hand with complete non use i.e. (House 0). In the previous study also this was a prominent finding with risk of developing joint and muscle contracture. We found that 45% of the spastic diplegia patients were in (House 7-8) with good grip and handling of the object with both hands .

Conclusion

Knowledge of hand function in a general population of children with CP is crucial in making treatment decisions for individuals as well as

planning for health services and resource needs. The overall spectrum of function in the hands of all children with CP living in the research area was characterised in the current investigation. Varied diagnostic subgroups showed various patterns of impairment, which could necessitate different therapy approaches. We feel it is critical to continue studying hand function in all children with CP over time in order to recognise and address difficulties caused by increased muscle tone and non-use as early as possible. Additional research is needed to create additional instruments for testing hand function in children with CP.

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