Original Research Article

Hand Function In Patients of Cerebral Palsy: A Prospective Study From Punjab

Hari Om Aggarwal[1], Ashish Kavia[2], Girish Sahani[1]
[1]Professor, Department of Orthopaedics, [2]Assistant Professor, Department of Physical Medicine & Rehabilitation
Government Medical College/ Rajindra Hospital , Patiala, Punjab, India

Corresponding Author:
Dr Girish Sahani
Contact : 9417222119 Email id : sawhneygirish@gmail.com

Abstract :

Introduction:

It is found that 10% of the global population has some form of disability from different causes; in India , it is 3.8% of the population. Nearly 15-20% of physically disabled children are affected by Cerebral Palsy. In India, the estimated incidence is around 3/1000 live births. Cerebral palsy is the most common motor disability in childhood.

The topographic classification of CP is monoplegia, hemiplegia, diplegia and quadriplegia; monoplegia and triplegia are relatively uncommon. Diplegia is the commonest form at 30%-40%.spastic CP is the commonest and accounts for 70%-75% of all cases.

Hand function is affected in cerebral palsy but studied very less and very little data is available on hand function in different cerebral palsy

Objectives:

To describe aspects of hand function in children with cerebral palsy

Methods:

This prospective study was conducted on 60 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 60 children of cerebral palsy. Hand function was classified according to the Manual Ability Classification System(MACS) and House functional classification system.

Results:

In the total population of children with Cerbral palsy aged 5 to 12 years , 81% had more than minor problems with hand function (>MACS 1). We found 23% of the children with MACS 5 with severe limitation of hand function. Only 19% of children were able to handle objects easily and successfully and were classified in MACS1.according to the house functional classification , both the Hands were spontaneously and independently used in 51% of children (house 7-8) , whereas 11% did not use either of their hands(House 0).

Conclusion:

Hand function limitations are present in all kinds of CP, however the features of the disability range significantly amongst CP subtypes. The MACS classification can be used to assess how well children manage things in everyday situations. The House functional classification depicts grip function in each hand independently.. All of these classifications have been found to be beneficial in a population-based health-care approach, although more research into the psychometric features of these classifications is needed.

Keywords:

Hand function, Cerebral Palsy, Manual ability classification system

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 births1. Hand functioning, or the capacity of the hands to operate effectively in a variety of situations, is dependent on the central nervous system's integrity, which can be disrupted by a variety of brain disorders. Cerebral palsy (CP) is the most common type of physical disability in children2, affecting one out of every 303 live births (http:// www.cdc.gov / ncbddd/cp/index.html). Almost half of all children with cerebral palsy have arm–hand impairment (3, 4). In daily activities, children with unilateral spastic CP rarely utilise their paretic hand (3, 5). As a result, in the recent decade, more emphasis has been paid to hand function in children with CP.

The influence of CP on a child's hand functioning can be defined using the International Classification of Functioning, Disability, and Health (ICF) theoretical framework (6). The ICF states that CP can impair three distinct but connected domains of functioning: body functions and structures (body domain), activities (person domain), and participation (participation domain) (social domain). Because the social component cannot be reduced to the sole function of the hands, only the body and individual domains were studied in this study. The physiological and psychological functions of the various bodily systems are referred to as body functions. The anatomical parts of the body are referred to as body structures.

CP is defined as the result of early brain injuries that damage the corticospinal tract. The hand and its components (e.g., muscles, joints, and bones), as well as various body functions, may be affected by CP (e.g., muscle strength, control of rapid coordinated movements, touch-pressure detection, and recognition of common objects and shapes). The ICF domain of activities, which refers to the ability to do a fundamental job or action of daily living, may also be limited by CP (e.g., eating, drink- ing, grooming, or dressing). Hand functions (ICF body domain) and hand mobility shall be referred to as "hand skills" in this work (ICF activity domain, mobility subdomain).

The term Manual ability (MA) will be used to refer to the children capacity to manage daily activities requiring the use of hands and upper limbs(ICF activity domain, self care subdomain)7 .

Cerebral palsy is the musculoskeletal manifestation of a non progressive central nervous system injury caused by a prenatal brain trauma. The musculoskeletal pathology is progressing, despite the fact that the brain injury is static. Spasticity causes the musculoskeletal units to shorten, resulting in permanent contractures, torsional anomalies of the long bones, joint instability, deformity, and degenerative arthritis8. The clinical manifestation might range from an intelligent child with moderate hand stiffness to a wheelchair-bound child who is unable to speak and completely ignores his or her affected upper limb.

However, all patients have the following characteristics 9:

- Cerebral palsy is caused by a brain injury. As a result, the structure and biochemistry of the spinal cord and muscles are both normal.
- The brain lesion must be non progressive and fixed. As a result, the definition excludes all progressive neurodegenerative illnesses.
- Motor impairment is caused by a brain disorder.

The spastic hand's intricacy stems from the fact that spastic muscles cannot be employed as tendon transfers as well as they can be in reconstructive surgery for the hand with flaccid paralysis10.

The aim of this study was to describe different aspect of hand function in cerebral palsy patients

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 were determined after 4 years of age according to the internationally accepted Swedish classification (SC).13 In this classification, spastic CP is divided into hemiplegia with unilateral involvement; diplegia, where spasticity dominates in the lower ex- tremities; and tetraplegia, where all 4 extremities are involved. In spastic tetraplegia, the upper extremities are usually more involved than the lower, and all these children have a severe functional disability.

Assessments

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

MACS: The MACS Table 1 class 1 classifies a child's ability to handle objects in daily activities on 5 levels (www.MACS.nu). Level I indicates the best and level V the lowest level of manual ability. The child's usual performance, not the maximal capacity, is classified. The level is determined by asking someone who knows the child about his or her typical performance and need of help to handle objects. The MACS does not aim to distinguish between different capacities in the 2 hands. It can be used in children from 4 to 18 years.

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: The House classification (Table 2) was developed for the evaluation of function in the affected hand after surgery for thumb-in-palm deformity in children with spastic hemiplegic CP.18 In the present study, the classification was used for each hand separately in all types of CP. The classification consists of 9 grades ranging from a hand that is not used at all (grade 0) to 1 that is used spontaneously and independently from the other hand (grade 8). In the present study, the evaluation was made through observation of the child in activities requiring bimanual hand function. First, the level of function in each hand— that is, no use (0), passive assist (1–3), active assist (4 – 6), or spontaneous use (7– 8)—was deter- mined, and subsequently an effort was made to subdivide into the 9 functional classes 0–8. Level 8 was considered as a normal hand used independently from the other hand.

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 a ctive 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

CP type	Subtype	Number of children
Spastic	**Hemiplegia** **Quadriplegia** **Diplegia**	11 5 27
Ataxic	**Ataxic**	6
Dyskinetic	**Athetoid** **Dystonic**	6 5

MACS

Distribution between MACS levels in the total patients is shown in Fig 1.

Out of 60 children 29 (48)percent were independent in age-relevant manual activities(MACS I and II), whereas 15(23)percent did not have any active hand function and were totally dependent on others in their daily day to day needs(MACS V).

Out of different subtypes of CP we found children with spastic hemiplegia having 8 out of 11(76%) were in MACS I and II.

Children with spastic diplegia having 19 out of 27(70%) were in MACS I and II. 4 out of 5(80%) children with quadriplegic CP and 12 out of 17(70%) with ataxic and dyskinetic CP were in MACS IV and V.

CP subtype	MACS I	MACS II	MACS III	MACS IV	MACS V	Total CP patient
Spastic hemiplegia	4	4	1	1	1	11
Spastic quadriplegia	0	0	1	1	3	5
Spastic Diplegia	8	11	1	5	2	27
Ataxic	1	1	1	1	2	6
Dyskinetic	0	1	1	2	7	11

The house functional classification

The Distribution of function according to the House classification is shown in Figure 2. The hand with the lowest level of function was called the non dominant hand and the other the dominant hand. In 30 children (51%), both hands were spontaneously and independently used (House 7– 8). There were 6 children (9%) with complete non-use (House 0) of 1 hand and 4children (7%) with non-use of both hands. Hand function according to House in children with different subtypes of CP is shown in Table 3.

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	2	9	11
	ND	0	1	3	7	11
Spastic quadriplegia	**D**	2	3	0	0	5
	ND	3	2	0	0	5
Spastic Diplegia	**D**	2	5	9	11	27
	ND	4	6	8	9	27
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**	6	15	19	20	60
	ND	9	19	16	16	60

Discussion

In our study we used MACS and The House

functional classification system to describe the hand function in the cerebral palsy children. Adequate hand function is crucial for obtaining independence in daily activities . In cerebral palsy hand function is hindered by an increase or varying muscle tone that causes imbalance and sometimes contractures. Now a days many new treatment are being used in the treatment of hand function like newer pharmacotherapies for reducing spasticity, surgical muscle tendon lengthening and transfer, botulinum toxin in affected muscles. Using these methods we can prevent against contractures and this is more achievable now. However still there is a need to identify the early problems in hand function is critical for planning ant kind of treatment.

Hand function is a very complex entity with different components of hand function such as gripping and releasing objects, reach, speed and accuracy, grip strength and others. Cognition is also an integrated and necessary requirement for a normal hand function. Study done by Nordmark E et al. And Beckung E et al. Found 50-70% of children with cerebral palsy have subnormal cognitive ability. But in our study we tried to exclude these children and included only those children with normal cognition. There is no single assessment that can evaluate the hand function in children with cerebral palsy as it is a complex entity and need more than one scale for assessing hand function.

We used MACS as basic estimate of the level of hand function. This is a classification which was developed by an international work group which previously showed good reliability and validity. A major limitation of mACS was that it can not distinguish between different capacities in the 2 hand.

In our study we also used The House functional classification which is a 9 level functional classification developed by House et al. . This classification is mostly used in the evaluation of the affected hand before and after surgery. Many previous studies also used this classification for evaluation of hand function like Marianne arner et.al. We used this classification to evaluate each hand separately in children with all types of unilateral or bilateral cerebral palsy children.

In our study we evaluated 60 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 spasticdiplegia 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 relevant 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.

References

1. Dias E, Doraelli P, Kishore M. Cerebral palsy in India-a brief overview. BMJ. 2017;356:j462.
2. Rosenbaum P. Cerebral palsy: what parents and doctors want to know. BMJ (2003) 326:970–4. doi:10.1136/bmj.326.7396.970

3. Fedrizzi E, Pagliano E, Andreucci E, Oleari G. Hand function in children with hemiplegic cerebral palsy: prospective follow-up and functional outcome in adolescence. Dev Med Child Neurol (2003) 45:85–91. doi:10.1111/j.1469-8749. 2003. tb00910.x
4. Arnould C, Penta M, Thonnard JL. Hand impairments and their relation- ship with manual ability in children with cerebral palsy. J Rehabil Med (2007) 39:708–14. doi:10.2340/16501977-0111
5. Pagliano E, Andreucci E, Bono R, Semorile C, Brollo L, Fedrizzi E. Evolution of upper limb function in children with congenital hemiplegia. NeurolSci (2001) 22:371–5. doi:10.1007/ s100720100067
6. World Health Organization. The International Classification of Functioning, Dis- ability and Health – ICF. Geneva: WHO (2001).
7. PentaM, TesioL, ArnouldC, ZancanA, ThonnardJL. The ABILHAND question- naire as a measure of manual ability in chronic stroke patients: Rasch-based val- idation and relationship to upper limb impairment. Stroke (2001) 32:1627–34. doi: 10. 1161/01.STR.32.7.1627
8. Graham HK, Selber P. Musculoskeletal aspects of cerebral palsy. The Journal of bone and joint surgery. British volume. 2003 Mar;85(2):157-66.
9. Herring J. Together Forever? The Rights an d Responsibilities of Adult Children and their Parents. Responsibility, law and the family. 2008:41-61.
10. Zancolli EA. Surgical management of the hand in infantile spastic hemiplegia. Hand clinics. 2003 Nov 1;19(4):609-29.