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Comparison of tactile preferences in children with spastic and dyskinetic cerebral palsy

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Abstract
Background and Objectives: Children with cerebral palsy have tactile processing deficits due to which there is a pattern of observable behavioral and emotional responses, which are aversive and negative to certain types of tactile stimuli. The object of this study is to determine if differences exist in tactile preferences exist between spastic and Dyskinetic cerebral palsy using Curry and Exner's Tactile Preferences and object recognition test.
Methods: 50 students (spastic=35, Dyskinetic =15) were selected based on inclusion and exclusion criteria, and data was collected using Curry and Exner's Tactile Preferences and object recognition in both the groups. Result was analyzed using appropriate statistical analysis
Results and Conclusion: Mann-Whitney test was used to compare the tactile preference between Spastic Cerebral Palsy (SCP) and Dyskinetic Cerebral Palsy (DCP) children and also to find the tactile discrimination in both the groups. The result showed that there was no significant difference in tactile preference between SCP and DCP with p ≥0.05. But there was difference in tactile recognition in objects like pencil and key (p-value 0.02). Hence, it was concluded that children with SCP and DCP had no difference in tactile preference.

Keywords: spastic cerebral palsy, dyskinetic cerebral palsy, tactile preferences, object recognition, sensory

Introduction

Cerebral Palsy (CP) describes group of permanent disorders of the development of the movement and posture causes that are attributed to non-progressive activity limitations that occurred in the developing infant [1, 2]. It affects the physical, social, emotional, financial well-being of individuals, families and society [3]. Secondary Muscular skeletal problems such as muscle/tendon/contractures, bony torsion, hip displacement, spinal deformity can contribute to functional deterioration.

The prevalence of CP cases is approximately 2 per thousand live births [4]. CP may be classified by the type of movement disorders as: - Spastic, Hypotonic, Dyskinetic or Ataxic [5].

Spastic CP (SCP) results from involvement of the Motor cortex or white matter projection to and from Cortical sensorimotor areas of the brain. Spasticity and exaggerated reflexes results in abnormal patterns of posture and movement.

Dyskinetic CP (DCP) reflects involvement of Basal ganglia. Dyskinetic features include Atypical patterns of posture and involuntary, uncontrolled, recurring and occasionally stereotyped movements of body parts. Dyskinetic CP may be classified further into Dystonic or Athetotic. Dystonic movement is dominated by involuntary sustained or intermittent muscle contraction with repetitive movements and abnormal postures. Athetosis is characterized by slow, continuous, writing movements that prevent maintenance of a stable posture [2].

The tactile system is one of the sensory systems which include nerves under the skin's surface that send information to the brain. This information includes light touch, pain, temperature, and pressure which play an important role in perceiving the environment as well as protective reactions for survival [6] It starts developing since 5th week of pregnancy; supports a child to influence recognize different types of touch sensations as the child that grows. Functionally, this system supports in two important aspects, sucking and establishing emotional security [7]. The sense of touch is enabled by "afferents sensitive to mechanical stimulation of the skin; they provide signals to the brain concerning the form, texture, location, intensity, movement, direction, and temporal cadence of mechanical stimuli, forms of somesthesis highly developed in the hand [8]". The sensations included in the sense of touch are also categorized as epicritic. In the galbrous skin, the sense of touch is mediated by four types of classically described cutaneous receptors (Merkel, Ruffini, Pacini, Meissner). Tactile information from the body travels through large myelinated axons in the peripheral nerves to the dorsal root ganglia. From there, the information ascends to the medulla via the ipsilateral dorsal columns (gracilis and cuneatus tracts). In the dorsal column nuclei, the second-order neurons send projections that cross the mid-line, where they form the medial lemniscus, which further ascends in the pons and mid-brain to terminate in the ventral posterior lateral nucleus of the thalamus. From there, third-order neurons send their axons to the primary somatosensory cortex in the post-central gyrus [9]. The "development of touch" sensation is dependent upon maturational processes affecting mechanoreceptor populations, cortical neurons and myelinated fibers [10].

Tactile sense is made up of two components. The protective system and descriptive system. The function of the protective or defensive system is to alert us to potentially harmful stimuli. Light touch is the stimulus that causes the receptors to respond. The discriminative system is associated with the function of tactile discrimination such as detection of size, form, texture as well as movement across the skin [11]. The discriminative system is served by dorsal column-medial lemniscus (DCML) pathway, the receptors associated with DCML are responsible for responding to mechanical stimuli transmitting vibratory, touch pressure discriminatory and deep pressure information [12]. It tells what one is touching /where on one's bodies it is touching and properties of the touch.

When infant develops into childhood, the descriptive system suppress the protective /defensive system although not completely. Both systems work together to enable us to interpret tactile information throughout our lives [13].

Tactile Defensiveness refers to a pattern of observable behavioral and emotional responses, which are aversive and negative to certain types of tactile stimuli that most people would find to be non-painful [14]. It is the response that occurs, when Dorsal column-medial lemniscus system fails to exert inhibitory influence over Anterolateral System. Due to this child exhibits strong emotional response and escape-like behaviour and strong emotional response. In this condition non-standard neural messages are being sent to the motor cortex which in turn, overly stimulates the brain activity that is disorganised. This overstimulation can cause individual difficult to organise the behavior [15].

Some children with CP have primary tactile processing deficits due to pathology in the cortical and subcortical areas involved in sensory processing, such as the somatosensory cortex, thalamus and cerebellum. Secondary tactile processing deficits may occur as a result of the motor limitations of children with cerebral palsy [16]. The etiologies of diplegic CP commonly involve pathology of the central nervous system that alters normal development of the somatosensory system. For example, recent diffusion tensor imaging in individuals with diplegic cerebral palsy showed prominent damage to the thalamocortical projections to the somatosensory cortex, with less frequent severe damage to the corticospinal tracts, despite a history and clinical presentation consistent with motor tract injury [17]. Lesions of the parietal lobe and/or the thalamus are often present when sensory discrimination in highly discriminative and spatially dependent functions is impaired or lost [18, 19, 20]. Hypertonicity and reduced active movement, for example, may affect a child's opportunities to experience tactile stimuli. Studies of primate and human brain plasticity have supported the theory that movement (or lack of it) and tactile experience affect tactile processing ability [21]. There are effects of both hypo-and hyper-responsivity to sensory stimuli and the impact of this on the treatment of children [22].

There are numerous reports associate motor impairments to somatosensory deficits in CP, providing a rationale for the importance of assessing tactile sensitivity in this population. Object recognition is a highly validated test for recognition memory. It can be used to test the efficacy of memory enhancing compounds, the (negative) effects of certain other compounds on memory, or the influence of genetics or age on memory among other things [23]. Impairment of tactile object recognition (TOR) in humans can result from inability to explore an object tactilely, basic somatosensory perception [24].

Materials and Methods

Research design

Non randomized comparative observational study

Sources of data

- Special schools and Rehabilitation centers located in Bangalore.
- Fame India special education school In Bangalore
- Samarthanam Trust for disabled in Bangalore
- Parijma Medical center in Bangalore
- Little BlueJays in Bangalore
- Ankura Foundation in Bangalore

Duration – 6 months

Sampling technique – Purposive sampling

Sample size

Total 50 samples were taken and were divided into two groups i.e. Group A spastic CP(n=35) and Group B Dyskinetic CP (n=15)

$$n = \frac{Z_{\alpha/2}^2 \times pq}{d^2}$$

Inclusion criteria

- Age group between 3-8
- Children diagnosed with Spastic /Dyskinetic cerebral palsy
- Children with mild retardation to normal range of intelligence
- Children who have attained sitting balance
- Parents who were willing to sign the written informed consent to allow their child to be part of the study

Exclusion criteria

- Severe motor involvement
- Profound to moderate MR
- Hyperactive behavior
- Visual and hearing impairment
- Unilateral neglect
- Children with any kind of peripheral nerve involvement
- Wounds scars in upper limb

Informed consent of the patient was taken, after explaining the purpose of the study and assuring them of confidentiality.

Equipments

Tactile Object Recognition: Participants first identified groups of five common objects. The test order followed probable decreasing prior familiarity with the touched objects. Objects touched within a group were presented in random order. The common objects were a key, penny, pencil, spoon, and button, and each was presented once all tactile objects were secured to a smooth, flat subsurface in an attempt to minimize the motor dexterity and exploratory strategy differences across sides and participants.

Tactile Preference: Five objects, all similar in size and shape but varied in texture, were used to assess the children's preferences for objects. Objects were constructed of each of the following materials: fur, foam, plastic brush bristles, sandpaper, and yarn, The fur and sandpaper objects were constructed by attaching the material to wooden dowels, The other objects consisted of only the actual materials-a piece of foam, the end of a hair brush, and a yarn ball. The brush bristles and sandpaper objects is considered hard objects, and the other three objects is considered soft. A 17 in. ×11 in. × 12 in. cardboard box was used as a means of concealing the objects from the subject's view during testing. The box was completely open in the back and had a curtain covered opening in the front. Objects were placed in the box from the back, and the subjects were asked to reach through the curtained opening. The bottom of the box was lined with a padded material to minimize noise created by object contact with the box. Each subject was tested individually in a small room. The subjects were positioned appropriately in their adapted chairs or in a small wooden chair or adult's lap. All subjects were asked to sit facing the examiner. Distractions were minimized during testing.

Procedure

i) Tactile object recognition

The limb order (dominant vs non-dominant) for testing was determined randomly. Participants were allowed to touch an object actively and freely for 5 seconds before naming it. A curtain occluded vision of the tested hand and object. The number of correctly identified objects for each hand was recorded for analyses.

ii) Tactile preferences

Each of the five objects was paired with every other object, resulting in ten pairs of objects. With this system, each object was presented twice to the left hand and twice to the right hand All possible combinations of the five objects were not used because this would result in too many pairs (and thus too long a test) for the subjects. The ten pairs were randomly ordered into fifteen different lists. Thus, each subject with spastic cerebral palsy received the object pairings in a different order. The same 15 lists of presentation orders were used with DCP subjects. This system was used to ensure that order effects would be minimized.

Once a subject is seated for testing and the box will be securely fastened to the desk or table in front of the subject, the procedures of the test were simply explained. The subject was told that this was a game. He or she was encouraged to reach through the curtain with both hands. The examiner placed the two objects approximately 5 in. apart and simultaneously place one of the subject's hands on each object. Once the examiner's hands were removed, the subject was asked to feel the objects and pullout the preferred one. The activity required only the ability to partially open the hand and use a gross grasp pattern. Verbal encouragement was provided to sustain the subject's attention to and cooperation with the test. The data collection form was designed so that the hand used to select each object and the object choices were both recorded. Each choice was recorded before the next pair was presented. Object Choice Frequencies for spastic children and dyskinetic children were recorded

Statistical analysis

Data collected for the study were analyzed using appropriate statistical test and results are given in terms of test photographs, tables and figures in following pages.

In the present study 50 children (35-SCP,15 –DCP) were included based on inclusion criteria. The percentage of students was more in the age group of 7-8 years i.e. 27%. Texture preference and tactile discrimination was measured on all using tactile preference and tactile recognition, it was found that there was no significant difference between both the group of children with CP with p value ≥0.05. It was found that there was difference in tactile object recognition in objects like pencil and key

Results

Age distribution

Spastic Cerebral Palsy

Table 1: Age distribution of subjects studied

Age in years	Number of subjects	Percentage
3-4	6	17%
4-5	7	20%
5-6	4	12%
6-7	6	17%
7-8	12	34%
Total	50	100%

The above table describes the number of subjects in each age category and percentage of each age group.

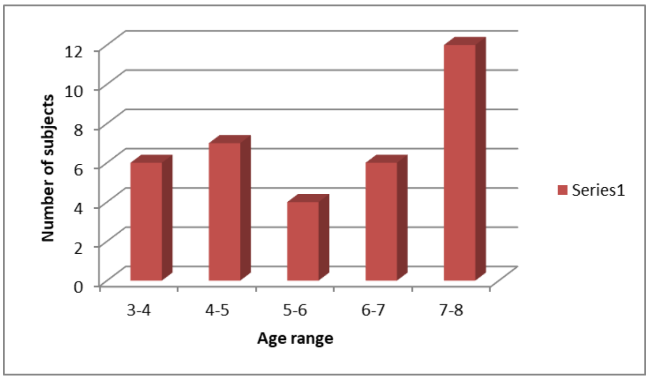

Fig 1: Age distribution of SCP subjects studied

The above fig represents the percentage of subjects in each age group of the study. Highest students being in the age group of 7-8 years and least in 5-6 years and 3-4years.

Dyskinetic Cerebral Palsy

Table 2: Age distribution of subjects studied

Age in years	Number of subjects	Percentage
3-4	2	14%
4-5	4	29%
5-6	3	22%
6-7	2	14%
7-8	3	21%
Total	15	100%

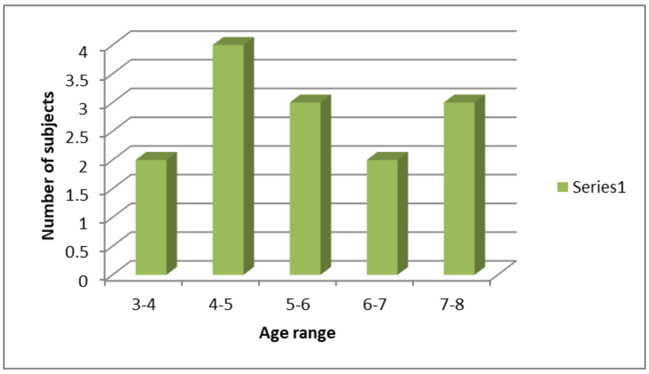

Fig 2: Age distribution of DCP subjects studied

The above fig represents the percentage of subjects in each age group of the study. Highest students being in the age group of 4-5 years and least in 3-4 years and 6-7years

Gender distribution
Spastic Cerebral Palsy

Table 3: Gender distribution of SCP subjects studied

Gender	No. of subjects	%
Boys	21	60%
Girls	14	40%
Total	35	100%

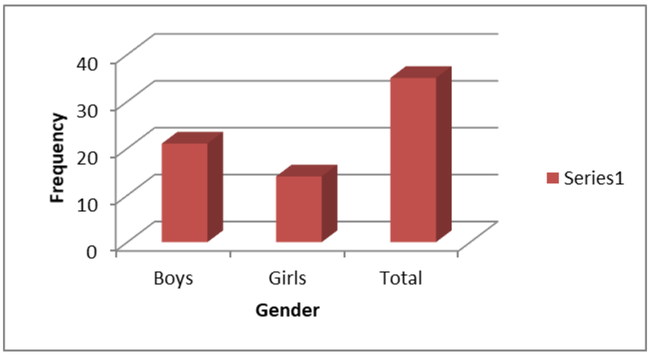

Fig 3: Age distribution of SCP subjects studied

Dyskinetic Cerebral Palsy

Table 4: Gender distribution of DCP subjects studied

Gender	No. of subjects	%
Boys	9	60%
Girls	6	40%
Total	15	100%

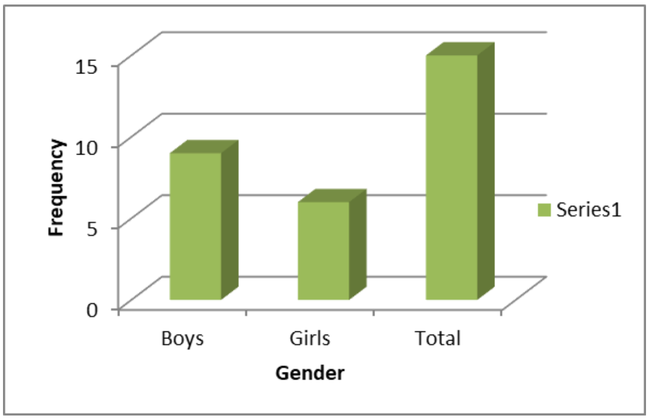

Fig 4: Gender distribution of DCP subjects studied

Hand dominance
Spastic Cerebral Palsy

Table 5: Hand dominance of the SCP subjects

Hand dominance	Number of subjects	Percentage
Right	23	66%
Left	12	34%
Total	35	100%

Fig 5: Hand dominance of the SCP subjects

Dyskinetic cerebral palsy

Table 6: Hand dominance of the DCP subjects

Hand dominance	Number of subjects	Percentage
Right	7	47%
Left	8	53%
Total	15	100%

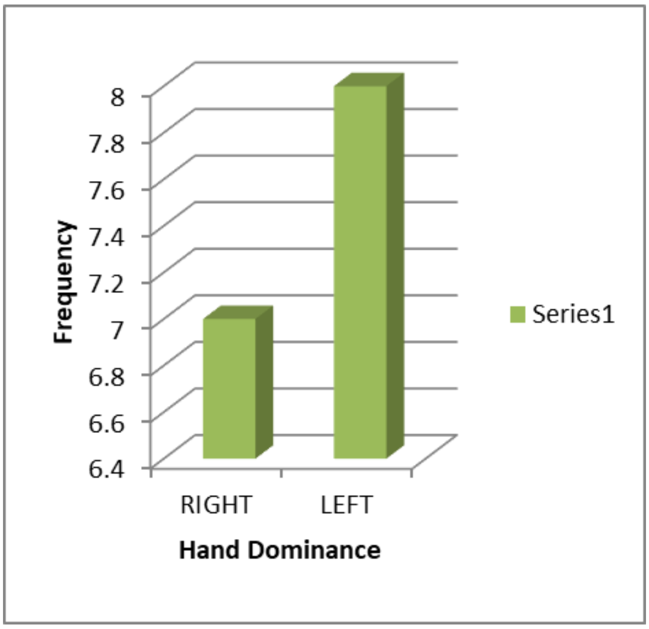

Fig 6: Hand dominance of the DCP subjects

Object preference
Spastic Cerebral Palsy

Tables 7: Object preference in Spastic cerebral palsy

Textures	Frequency	Percentage
Fur	115	22%
Foam	90	18%
Yarn	90	17%
Sandpaper	110	21%
Brush	113	22%

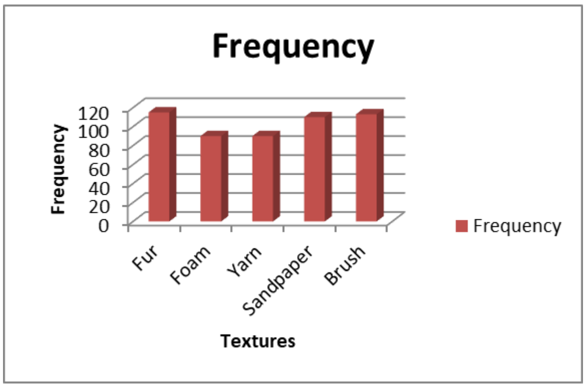

Fig 7: Object preference in Spastic cerebral palsy

Dyskinetic Cerebral Palsy

Table 8: Object preference in Dyskinetic cerebral palsy

Textures	Frequency	Percentage
Fur	48	24%
Foam	15	7%
Yarn	54	26%
Sandpaper	50	24%
Brush	39	19%

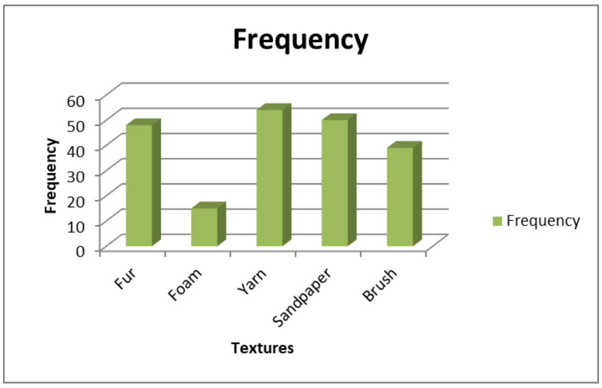

Fig 8: Object preference in dyskinetic cerebral palsy

Object recognition
Spastic Cerebral Palsy

Table 9: Tactile recognition in Spastic cerebral palsy

Objects	Recognized	Percentage
Spoon	26	25%
Key	26	25%
Pencil	26	25%
Coin	16	15%
Button	11	10%
Total	35	100%

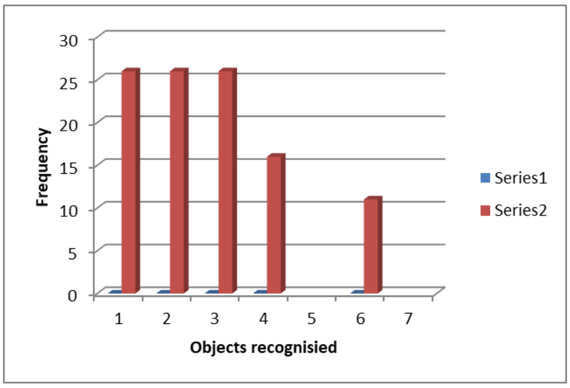

Fig 9: Tactile recognition in Spastic cerebral palsy

Dyskinetic Cerebral Palsy

Table 10: Tactile recognition in Dyskinetic cerebral palsy

Objects	Recognized	Percentage
Spoon	7	26%
Key	6	22%
Pencil	6	22%
Coin	5	19%
Button	3	11%

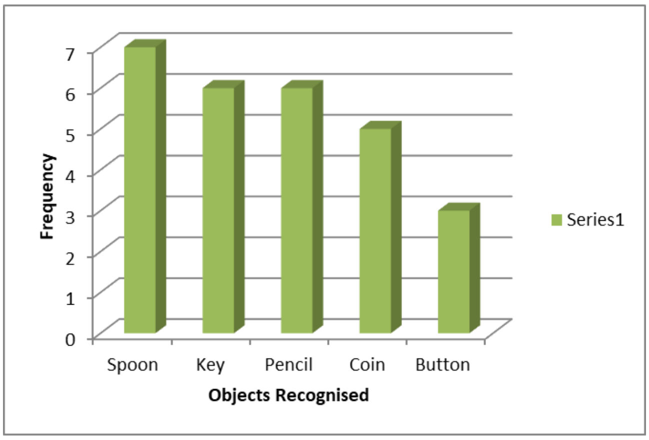

Fig 10: Tactile recognition in Dyskinetic cerebral palsy

P –value and Z-value of all objects being tested in both the groups

Table 11: The table describes P –value and Z-value of all objects being tested in both the groups

Objects	P-Value	Z-Value
Fur	0.957	0.893
Foam	0.633	0.478
Brush	0.419	0.808
Yarn	0.740	0.332
Sandpaper	0.788	0.269
Spoon	0.061	1.870
Key	0.022	2.291
Pencil	0.022	2.291
Coin	0.421	0.805
Button	0.414	0.816

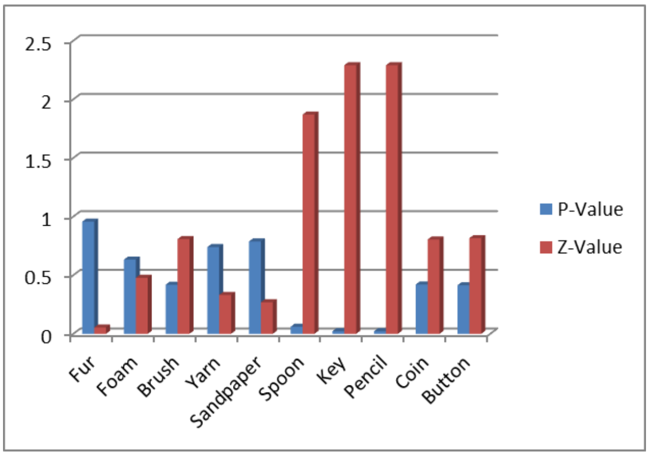

Fig 11: The figure describes P –value and Z-value of all objects being tested in both the groups

Median and inter-quartile value of both the groups

Table 12: Median and Inter-quartile value of both the groups

Objects	Median		Inter-quartile	
	Spastic	Dyskinetic	Spastic	Dyskinetic
Fur	3	3	2	1
Foam	3	2	2	1
Brush	3	4	2	2
Yarn	3	2	1	3
Sandpaper	3	3	3	2
Spoon	1	0	1	1
Key	1	0	1	1
Pencil	1	0	1	1
Coin	0	0	1	0
Button	0	0	1	0

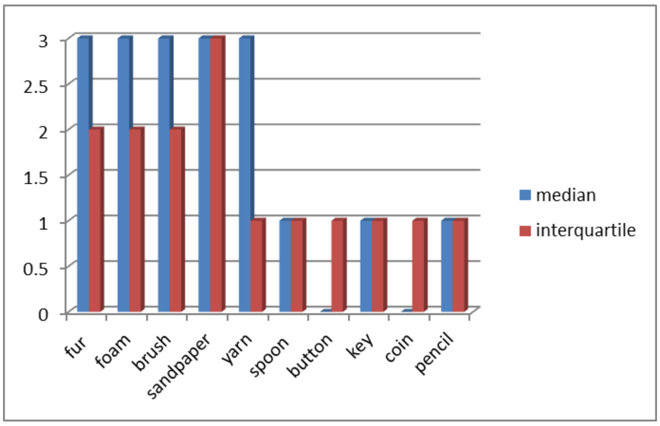

Fig 12: Spastic cerebral palsy –Median, Inter-quartile

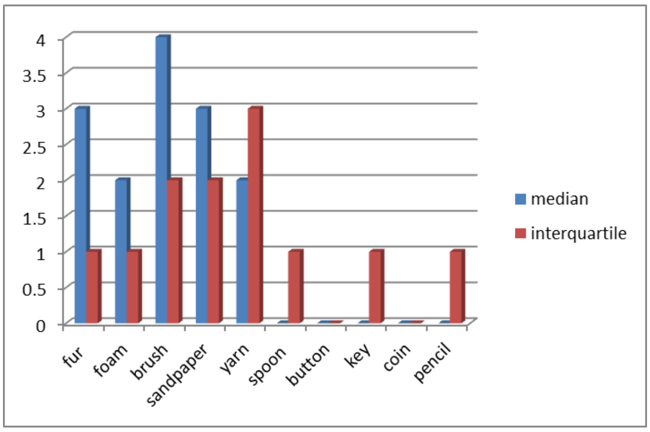

Fig 13: Dyskinetic cerebral palsy –Median and Inter-quartile

Discussion

The present study determined the tactile preference with SCP and DCP between the age group of 3-8 years using tactile object preference and tactile recognition test was used to determine the tactile discrimination in children. Understanding the tactile preference in developing children will help to analyze the child's sensitivity to certain textures herby help in the treatment like sensory re-education and make certain changes in their play environment. Understanding the tactile object recognition in the upper extremity helps in all aspects of the daily living. It is the ability to feel and recognize what the hand grasps using cues from textures, size and shapes.

In the previous study done by Jason R Wingert *et al*. in children with cerebral palsy showed that diplegic and hemiplegic CP had differences in tactile object discrimination, our study on SCP and DCP showed that there was significant difference in tactile object recognition for objects like key and pen as the children with SCP could actively grasp the objects which was presented and then could manipulate it as they had good active assistance, whereas children with DCP could grasp the objects and hold it weakly but they could not manipulate the objects, this might have lead to inability to discriminate between the objects.

Another study conducted by Margaret Yekutiel *et al*. in children with Spastic and Athetoid cerebral palsy and children who had poliomyelitis in their infancy. They used object recognition, two point discrimination to assess the sensory deficits. Out of 55 CP subjects 6 were Athetoid and it was concluded that children with spastic cerebral palsy were found to be much more likely to have sensory disturbances than those with Athetosis, in contrast we had 35 SCP and 15 DCP subjects and have found that there was no statistically significant difference between both the groups.

In the present study we have used tactile object preference in both the groups. The study was replicated with the use of all possible pairs and their reciprocals so that the possible interaction of hand preference and object selection was used which was recommended in the study done by Exner *et al*. using tactile preference. There has been no significant change in the tactile preference, both groups preferred both hard and soft textures. There was no influence of hand dominance on the tactile preference of spastic cerebral palsy, whereas the subjects with Dyskinetic cerebral grasped the textures which was approachable rather than manipulating it as there was involuntary writing movement, it was difficult for the subjects to grasp the objects and pull it out completely. There was no influence of gender in the tactile preference and object recognition in either group. This study is therefore a re-confirmation which may help to direct interest to a relatively neglected aspect of CP. This deficit had been neither tested for nor diagnosed in these children. The implications-for training in activities of daily life, use of appliances, and decisions about surgery-are clear: all aspects of the child's management must take the sensory deficit into account. At the same time, the possibility of improving hand sensation in these children by systematic sensory training should be explored.

Conclusion

As per the object proposed for the present study the results concluded that there was no significant difference in tactile preference between both groups. There was difference in the tactile object recognition between the two groups in objects namely key and pencil. If this method were demonstrated to be a reliable and valid measure of general somatosensory perception in young children with disabilities, the effects of intervention designed to remediate any dysfunction in this area could be measured. Perhaps "sensory education" (similar to the sensory reeducation done with older individuals) is appropriate for this population of children. Such intervention might have a greater effect on the child's overall hand function if it were provided at a very early age rather than when the child is old enough to respond accurately to more traditional sensory evaluations

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