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Observational Study of Dynamic Splints on Daily Activity Task Achievement For Children With Spastic Cerebral Palsy

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Abstract

Background: Cerebral palsy is a developmental brain disorder that leads to decreased motor function of the extremities, especially on the hands. The provision of dynamic splints would be expected over time to contribute to functional hand improvement, such as gross motor function.
Aims: To observe the time in daily activity achievement for patients with spastic cerebral palsy while wearing dynamic hand orthosis.
Methods: Quantitative with pre-test post-test design. Ten CP children with an age range of 8 - 17 years with mild to moderate spasticity were observed before wearing and after wearing dynamic hand orthosis to do 7 tasks (Jebsen-Taylor Hand Function Test).
Results: After 2 weeks wearing the device, all participants showed different results indicating an improvement of 5.5 seconds to all tasks on the Jebsen-Taylor Hand Function Test.
Conclusion: Dynamic splints have an influence on increasing the time to complete the tasks, thus can be considered along with regular exercise.

Keywords: Cerebral palsy, Spastic, Dynamic splint, Functional hand, Jebsen-taylor hand function test

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Introduction

Cerebral palsy is described as a motor function disorder that usually occurs in childhood. It is seen to have features such as paralysis, weakness, impaired coordination, or abnormal brain activity. Cerebral palsy can cause learning difficulties, mental disorders, impaired sensory function, seizures, and inability to adapt to the environment in children (Sadowska et al., 2020).

The physical condition of a child with cerebral palsy can differ depending on the severity. However, the general description of cerebral palsy is the inability to move their limbs actively and difficulty doing activities like normal conditions, such as walking, crawling, holding an object, eating, and so on (Picture 1).



Picture 1 Hand Deformity Condition in Children with Cerebral Palsy

A study from (Daoud et al., n.d.) found that around 83% of patients with cerebral palsy attacked the upper extremities. With symptoms of decreased hand control as much as 69% and contractures as much as 39% with a pattern of hands forming flexion at the wrist (Makki et al., 2014). This makes it difficult for a person to perform activities such as holding and carrying objects, then the fingers lose control to pick up large and small objects with or without a precise grip. Although the condition is permanent or incurable, there are treatments that can help a cerebral palsy survivor.

As of now, many children with spastic cerebral palsy are given static splints and positioning to prevent contractures and decrease muscle tone (Maksoud et al. 2011). However, it cannot improve hand functionality as hands that are in a static or stationary position led to decreased function of the forearm muscles when grasping an object and in the long-term lead to atrophy and fatigue of the shoulder muscles from assisting the movement (Burtner et al., 2008). Dynamic splints are one of the tools that can assist hand movement according to the wearer's needs. A study showed that this type of dynamic splint can be an alternative to conservative treatment for children in restoring functional movement in upper body movements (Jackman et al., 2014) because dynamic splints will help stimulate fine motor dexterity and improve hand grip (Burtner et al., 2008).

This study was generally conducted to find the effect of dynamic splints in helping hand movement activities in children with spastic cerebral palsy and to determine the average speed of hand activity time before and after using dynamic splints. This study has a hypothesis that there is a functional effect of the hand before and after the use of dynamic splints.

Methods

This research is a quantitative approach with descriptive methods using a pre-experimental design that is one-group pre and posttest. The population in this study were all cerebral palsy children registered at Rumah Cerebral palsy Korwil South Jakarta which were then taken several samples with the following inclusion criteria:

1. Cerebral palsy with spastic not more than 2 (MAS)
2. Never used dynamic splint
3. No fracture

Some children were not selected as samples because they were included in the exclusion criteria, namely having a history of fractures in the wrist area, deformities in the fingers such as boutonniere and swan neck, and no history of physiotherapy control in the upper extremities.

Technically, this study uses the Jebsen-Taylor Hand Function Test as a measurement of hand functional speed performed before and

after dynamic splint use. Participants will be asked to adhere to using the dynamic splint for two weeks. Then the analysis in this study used SPSS Version 26.0.0 software (application programme). The analysis was carried out univariate and bivariate, univariate analysis was useful to see the distribution of participant characteristics during this study and bivariate analysis to see differences in hand functional speed before and after wearing dynamic splints for two weeks. The bivariate analysis used was the Shapiro-Wilk test with non-parametric analysis of the Wilcoxon Signed Rank Test.

Results

This study was mostly dominated by boys with an average age of 8 - 11 years. This study was dominated by cerebral palsy children who had triplegia topography with the level of hand activity still assisted by the hand that was not affected by spasticity as a stabilizer (Table 1).

Table 1. Frequency Distribution of Participant Characteristics

Participant Characteristics	Frequency (n)	Percentage (%)
Gender		
Male	7	70%
Female	3	30%
Total	10	100%
Age		
8 – 12 Years Old	8	80%
13 – 17 Years Old	2	20%
Total	10	100%
Topography of Cerebral palsy Impact		
Monoplegia	2	20%
Triplegia	4	40%
Hemiplegia	3	30%
Paraplegia	1	10%
Total	10	100%
Bimanual Degree		
Degree 1	1	10%
Degree 2	2	20%
Degree 3	5	50%
Degree 4	2	20%
Total	10	100%
Hand Function Level		
Level 2	1	10%
Level 3	3	30%
Level 4	2	20%
Level 5	2	20%
Level 6	1	10%
Level 8	1	10%
Total	10	100%

This study presents the results of functional speed between before and after 2 weeks of dynamic splint use. With an average range of speed before using the tool on the 7 subtests of the Jebsen-Taylor Hand Function Test of 40 - 410 seconds and the average range of speed after two weeks of using the tool ranging from 39 - 400 seconds (Table 2).

The fastest average time speed was found in the subtest of turning over paper with a range of 19- 63 seconds and the slowest was found in the subtest of lifting heavy objects with a range of 124 - 533 seconds before wearing dynamic splints. After two weeks of wearing the dynamic splint has a change even though the fastest and slowest time is still found in the subtest of turning the paper with a time range of 13 - 62 seconds and the subtest of lifting heavy

objects with a time range of 90 - 532 seconds.

Table 2. Average Speed of Hand Activity Time Before and After 2 Weeks of Dynamic Splint Use

Jebsen-Taylor Hand Function Test	Mean ± SD
Writing	
Before	316.17 ± 66.84
After	311.20 ± 71.78
Flipping paper	
Before	42.40 ± 11.24
After	39.44 ± 12.46
Taking Small Object	
Before	94.98 ± 28.82
After	88.32 ± 33.55
Feeding Simulation	
Before	133.29 ± 42.13
After	127.98 ± 45.45
Stacking Checkers	
Before	84.28 ± 22.42
After	80.57 ± 25.75
Lifting Light Object	
Before	244.52 ± 74.52
After	238.83 ± 78.82
Lifting Heavy Object	
Before	407.83 ± 108.78
After	397.05 ± 121.69

This is also evidenced by the mean increase in speed on all Jebsen-Taylor Hand Function Test subtests by 5.5 seconds (Mean Rank = 5.50) and after the use of dynamic splints on all Jebsen-Taylor Hand Function Test subtests with a significance number below 0.05 (Table 3).

Discussion

This study found that most of the participants had a degree or level 3 on the MACS measure (n = 5), which means that many of the participants had difficulty handling the object with difficulty and required other movement assistance (modification) to reach the object. A previous study found that there were children with cerebral palsy who had degree 3 on the MACS measurement in a considerable frequency (Eliasson et al., 2017). Another study mentioned that this can occur due to spasticity in the muscles, especially in the wrist, which has an impact on reducing the movement of the fingers and the need for other movement modifications in order to reach objects more easily (Bhardwaj & Sabapathy, 2011). Decreased hand function in cerebral palsy children decreases stability so there is a need for a stabilizer on the other hand to assist in moving the hand. This study also found that most participants had a degree or level 3 on the HFC measurement (n = 3), which means that they can use the main hand for grasping and the other hand for stabilization. Previous studies have found that there are children with cerebral palsy who have grade 3 on HFC measurements in a relatively low frequency (Arner et al., 2008). This can happen because weak hand function requires sufficient stability to perform some tasks, especially tasks that require more strength such as lifting heavy objects.

The mechanical components in the dynamic splint help stimulate the hand to perform a movement. The results of this study show differences in speed improvement before and after wearing dynamic splints when testing using the Jebsen-Taylor Hand Function Test method. The difference in speed value is divided into 7 subtests in accordance with

previous research oriented to hand functionality (Tofani et al., 2020).

Other studies have also found differences in average speed before and after the use of dynamic splints. In this research, the researcher only saw the difference in speed performance when participants before and after using dynamic splints for 2 weeks (Yang et al., 2021).

These results are in accordance with previously reported studies (Manurung & Setyanto, 2021) that dynamic splints can help hand strength and increase movement speed to perform several tasks, such as writing, eating, picking up an object, and lifting light and heavy objects.

Another study states that using dynamic splints regularly and gradually, will make the grip and dexterity of the hand increase because the movement of the fingers is assisted by dynamic components to stimulate the muscles to work in forming movements such as clenching and expanding (Burtner et al., 2008). This can train muscle strength, especially the small muscles in the palm area and avoid the risk of atrophy and contracture.

Conclusion and Recommendation

Based on the results of data analysis and discussion, researchers obtained conclusions that can be drawn from research on the effect of dynamic splints on hand activity in spastic cerebral palsy children at Rumah Cerebral palsy Korwil South Jakarta that the use of dynamic splints for two weeks can have an effect on increasing hand functional speed by 5.5 seconds in spastic cerebral palsy children aged 8-17 years who have fairly good hand movement abilities.

Future researchers are also advised to conduct research on the effect of dynamic splints and look for other causes of factors that affect the speed in completing the 7 subtest simulation in this study and look for relationships between test results in each group of participant characteristics so that dynamic splints can be used in more specific participants and provide optimal results.

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