Contents Lists is Available Online
International Journal of Motor Control and Learning (IJMCL)
Journal Homepage: www.ijmcl.com

The Effect of Reciprocal Imitation Training on the Function of Upper Limbs and Motor Skills of Children with Cerebral Palsy

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Keywords

Cerebral Palsy
Reciprocal Imitation
Gross and Fine Motor Skills

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Received: 2021/02/01
Accepted: 2021/05/07
Published: 2021/05/19

Abstract

Background: Cerebral Palsy (CP) is one of the most common disorders affecting movement disorders and impairments of cognition, visual, language and communication. However, there is still a lack of interventional therapy which involves Reciprocal Imitation Training (RIT) intended to improve imitation skills of children with CP.
Objective: The aim of this study was to determine the effect of reciprocal imitation training on the function of upper limbs and motor skills of children with cerebral palsy.
Method: 20 children with cerebral palsy were selected from Tavana Rehabilitation Center of Tabriz city using charter method and were divided into two groups of reciprocal imitation and control randomly. The subjects of reciprocal imitation group were trained with reciprocal imitation training and control group did not receive any training. Lincoln-Osertsky Motor Development scale was used to collect the information from subjects.
Results: The results of covariance test indicated that reciprocal imitation training can improve the function of upper limbs and motor skills of children with cerebral palsy ($P < 0.05$).
Conclusion: Therefore, it can be concluded that reciprocal imitation training is as an effective strategy for improving the motor skills with cerebral palsy.

Introduction

Cerebral palsy is one of the permanent but non-progressive motor disorders which happens due to the incidence of lesion in the growing brain (Lim, Binast & Wang, 2009). This brain injury occurs during fetal period, birth, infancy and childhood ((Dalnoud, Dehghan & Feizi Avat, 2011). Cerebral palsy outbreak is reported 2-3 per thousand in the world and 2.06 per thousand in Iran (Gharib, 2012) and its onset is in the early childhood but affects the whole scope of person's life (Tasoujian, Shujauddin & Abbasi,2015). In cerebral palsy various skeletal muscle parts may involve in different forms and cerebral palsy segmentation based on the muscle tone and the involvement of other parts of the brain except pyramid system includes Spastic, dyskinesia (Atheoid, ataxic, Butter forum), Hypotonic and mixed based on the involvement of various parts has different types of Monoplegia, Hemiplegia, Diplegia and Quadriplegia (Gharib, Hosseini & Akbari, 2010) which experience different motor disorders depending on the involvement type.

One of the motor disorders of children with cerebral palsy is the limits and restrictions on the function of upper limb muscles, reduction of motor range of upper limb joints such as wrist and elbow, loss of ability to perform fine motor actions and

hand manipulation skill (Gharib, Hosseini & Akbari, 2010). These disorders are influenced by factors such as muscle weakness of limbs, sensory deficits, Ataxia, Dyskinesia and spasticity, contraction and contracture (Gharib ,2012). The general opinion is that the existence of such restrictions reduces the life quality rate of these people and makes them dependent on others in terms of their mobility and self-care and affects their participation in everyday activities and their quality of life (Shariat, Abedi ,2010). Although cerebral palsy in children is not fully cured and motor disability and its induced disability remains throughout the life and in other words is non-treatment; but motor patterns can be changed during growth or puberty and/or with some rehabilitation approaches and psychological interventions.

One of the most effective rehabilitation approaches is constraint-induced movement therapy (CIMT), due to its proven high effectiveness and its ability to improve both unimanual and bimanual function (Klingels, 2013) and CIMT can improve upper limb motor execution in children with CP (Cristina, Lisa & Ellen, 2020). Apart from motor execution problems, children with CP may also have difficulties in motor representation and motor planning (Steenbergen, 2007 & Mutsaarts, 2006) and imitation skills (Ingersel, 2008). Action-Observation Training (AOT), a novel treatment approach aimed at activating the mirror neuron system (Cristina, Lisa & Ellen, 2020) can target the motor representation and motor planning difficulties. Mirror neurons are a particular class of visuomotor neurons that discharge both when we execute a particular motor action, and when we observe another individual executing the same action (Klingels, K 2013). It seems that through observation, we may learn how to imitate the movements required to perform a specifc action (Buccino,2006); which can be translated into skill learning. But it is clear that these approaches must relate to imitation skills in children with CP. Imitation defects in CP are shown in different forms; including body movements, use of object functional application and etc. So, teaching of imitation is a tool for social interaction (Ingersel, 2008); so, it may be useful for learning new movement skills in rehabilitation. Reciprocal imitation training is a naturalistic method and the main emphasis is on the social role of imitation in classical behavior and other training programs, such interventions are also in adequate compliance with all strategies that can eventually lead to the enhancement of reciprocal behavior (Ingersel 2008). Reciprocal Imitation Training (RIT) intended to improve imitation skills of children with with Developmental Disabilities to improve motor movement skills (Whitmore, 2015). Various researches have indicated the relation between imitation, motor movement, and language skill in young children with developmental disabilities and showed that the significant imitation-language relationship exists for young children with a variety of developmental disabilities. More importantly, in this study contributed evidence about how the nature of the imitation-language relationship is impacted differently based on diagnosis when motor movement skill is included into the

relationship. This information is important because it may be able to improve the outcomes of early interventions focused on imitation that also utilize a variety of motor movements (Whitmore, 2015). Therefore, this technique may be promoted the social skills and possibility of using the Action-Observation Training in order to promote the rehabilitation plan. However, the efficacy of RIT to a well-established psychological approach has not yet been investigated in children with CP. The aim of this current study is to answer this hypothesis that does reciprocal imitation training affect the function of upper limbs and motor skill of children with cerebral palsy?

Method

The current study is a semi-experimental and the statistical populations of this study were children with cerebral palsy from Tavana daily rehabilitation training center for physical and motor disabled in Tabriz city with an age range of 5 to 14 years which 20 of them were selected using available sampling method and by considering inclusion criteria. These criteria were: catching the disease of cerebral palsy, volunteer to attend training sessions, age range of 5 to 14 years, lack of catching any other disease like mental retardation, hydrocephalus, microcephaly and/or other diseases and patients undergoing rehabilitation treatments (occupational therapy, physiotherapy, speech-language pathology (speech therapy), psychology). Parents of children with cerebral palsy signed the consent form and then the subjects were randomly divided into two groups of reciprocal imitation (10 persons) and control group (10 persons). The subjects of reciprocal imitation group were trained by reciprocal imitation training 2 sessions per week for 20 minutes and control group subjects did not receive any training. At the beginning of reciprocal imitation training first of all the therapist imitated the child's body movements with various toys and verbal sounds and after attracting child cooperation by the therapist, he/she were addressed to the new and purposeful activities along with verbal sign and physical guidance. In this case, the child has become familiar with new activity and its verbal index and will find the motivation for imitating the therapist's movements children. we were excluded from continuing the training programs in case of child absence in 3 sessions of educational programs and lack of parental consent. Lincoln-Osertsky Motor Development scale was used to collect the information about subjects' upper limbs function and motor skills before and after training in both groups (Sloan W., 1955). Descriptive statistics (dispersion index, standard deviation and measures of central tendency) and analysis of covariance test was used for testing hypotheses in order to analyze information statistically.

Results

Evaluating the studied groups in this study using descriptive statistics indicated that the mean and variable standard deviation of fine motor skills in reciprocal imitation group in pretest and posttest is 37 and 4.72 and43.71 and 4.75, respectively. The mean and variable standard deviation of gross motor skills in reciprocal imitation group in pretest and posttest is 3.71 and 0.95 and 5.57and 0.78,

respectively. In this group the mean and variable standard deviation of upper limb in pretest is equal to 50.28 and 4.37.

The mean and variable standard deviation of fine motor skills in control group in pretest is equal to 40.57 and 4.68. The mean and variable standard deviation of gross motor skills in this group in pretest is equal to 3.71 and 1.11 and in posttest is 4 and 0.81. In this group the mean and variable standard deviation of upper limb in pretest and posttest is 51.42 and 4.79 and 52.28 and 5.21, respectively (Table 1).

Table 1. Description of Reciprocal imitation in studied groups.

Group	*Variable*	*Pretest M(SD)*	
Imitation	**Fine motor skills**	**37±4.72**	**43.71±4.75**
	Gross motor skills	**3.71±0.95**	**5.570±0.78**
	Upper limb	**50.28±4.37**	**62.42±4.99**
Control	**Fine motor skills**	**38.57±5.12**	**40.57±4.68**
	Gross motor skills	**3.71±1.11**	**4±0.81**
	Upper limb	**51.42±4.79**	**52028±5.21**

The results of univariate analysis of covariance on research indicators in table 2 indicated that by controlling the pretest effects:

- Reciprocal imitation method has had significant enhancement in the function of upper limb of children because the value of calculated F (49.60) is significant at level of $P < 0.05$.
- Reciprocal imitation method has had significant enhancement in fine motor function because the value of calculated F (20.41) is significant at level of $P < 0.05$.

Reciprocal imitation method has had significant enhancement in gross motor function of children with cerebral palsy because the value of calculated F (25.37) is significant at level of $P < 0.05$.

Table 2. Analysis of covariance-the effects of reciprocal imitation method on the upper limbs function.

Index/variation sources	Sum of squares	Mean of squares	Degree of freedom	F	Significant level	ETA squared
Group	**296.34**	**296.34**	**1**	**49.60**	**0.001**	**0.81**
Error	**65.71**	**5.97**	**11**	**-**	**-**	**-**
Total	**48223**	**-**	**14**	**-**	**-**	**-**

Table3. Analysis of covariance-the effects of reciprocal imitation method on the fine motor functions.

Index/variation sources	Sum of squares	Mean of squares	Degree of freedom	F	Significant level	ETA squared
Group	**69.95**	**69.95**	**1**	**20.41**	**0.001**	**0.65**
Error	**37.69**	**3.42**	**11**	**-**	**-**	**-**
Total	**25166**	**-**	**14**	**-**	**-**	**-**

Table4. Analysis of covariance-the effects of reciprocal imitation method on the gross motor functions.

Index/Variation sources	Sum of squares	Mean of squares	Degree of freedom	F	Significant level	ETA squared
Group	**8.64**	**8.64**	**1**	**25.37**	**0.001**	**0.69**
Error	**3.74**	**0.34**	**11**	**-**	**-**	**-**
Total	**337**	**-**	**14**	**-**	**-**	**-**

Discussion

This is the first study investigating the effect of reciprocal imitation on the function of upper limbs and motor skills of children with CP in the age range of 5 to 14 years. The results of our research indicated that reciprocal imitation training improves the function of upper limbs and gross and fine motor skills of children with cerebral palsy.

Children with cerebral palsy with pervasive motor disorders have many problems in motor skill and sensory, perceptional and cognitive, communicative and behavioral skills (Ingersel 2008). The upper limb motor and sensory deficits in children with CP hinder their performance of daily life activities. As we previously stated, the effects of CIMT and AOT in rehabilitation procedure was proven in improvement of upper limb function in children with CP (Simon-Martinez, C., 2020) by promotion in motor representation and motor planning. However, the ability of using of this technic mostly related to imitation skills in children with CP. Mirror neurons are a particular class of visuomotor neurons that discharge both when we execute a particular motor action, and children must observe and imitate another individual executing the same action (Rizzolatti, 2013). Children with CP learn how to imitate the movements required to perform a specifc action through observation (Buccino,2006); which can be translated into skill learning such as upper limb function in rehabilitation. Reciprocal Imitation Training (RIT) was first described by Ingersoll and Gergans (2007). We trained children with CP with Reciprocal imitation technic in 5 training phases: 1) therapist contingently imitates child, 2)therapist models familiar actions with the same toy as the child; 3) therapist models familiar and novel actions with the same toy as the child; 4)using a different toy than the child, therapist models familiar actions; 5)using a different toy than the child, therapist models familiar and novel actions and in a result their the function of upper limb, fine motor function and gross motor function was improved. The results of our study were consistent with the findings of previous researches (Krapis,

2014). In this regard, a study with the aim of examining the relation between upper limb function with the quality of life in children with cerebral palsy using stratified random sampling method indicated that there is a significant relation between the function components of upper limb with all components of the quality of life and having high level of upper limb function is synonymous with efficiency of higher quality of life quality level and its different domains (Sakzewski, 2007& Malik, 2016).Previous research proposed RIT as an effective therapy tool that can be used with children as young as 20month to improve imitation skills. They proposed that RIT can be used to treat both object and gesture imitation deficits. However, the precise mechanism of action is unknown: RIT encompasses several different language facilitation strategies including contingent imitation, linguistic mapping, and physical prompting (Whitmore, 2015 & Krupicz, 2014). Therefore, reciprocal imitation method as a learning strategy can be a way for acquiring new skills including motor skills and beyond that can be a basis for many therapeutic interventions of children and adolescents.

There is one limitation in this study. This study's sam ple size was calculated to find improvements larger than the smallest detectable difference. However, a total sample of 20 children, after counting for missing participant data is below the calculated sample size and it may be insufficient.

Conclusion

Overall, this study provides evidence that Reciprocal Imitation Training is an effective method for young children with cerebral palsy for acquiring new skills including motor skills and beyond that can be a basis for another therapeutic interventions of children and adolescents with CP such as AOT. Considering the ease of implementation and executive capability of reciprocal imitation training program, the trainers of rehabilitation centers and preschool and even parents of children with cerebral palsy disorder can easily implement this interventional program and they can practically take effective steps towards training the required motor skills of children with cerebral palsy in educational and social environments.

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