Original Research Paper

Volume - 7 | Issue - 5 | May - 2017 | ISSN - 2249-555X | IF : 4.894 | IC Value : 79.96

Rehabilitation Science

Physical Rehabilitation Techniques to Improve Hand Function in Cerebral Palsy

Mr. C. Elanchezhian	Research Scholar, PG & Research Department of Rehabilitation Science Holy Cross College (Autonomous Tiruchirapalli-620002)
DR. P. Swarna Kumari	Associate Professor, Research Supervisor, PG & Research Department of Rehabilitation Science Holy Cross College (Autonomous Tiruchirapalli-620002)

ABSTRACT Cerebral palsy (CP) and brain injury can have devastating effects on children's ability to use their hands. Brain lesions may disturb hand functioning in children with CP, making it difficult or even impossible for them to perform several manual activities. Limitations in fine motor skills make independent living problematic if not impossible and negatively impact everyday functioning in terms of educational, professional, and social activities. The aim of CP rehabilitation is to improve existing functions and compensatory mechanisms and to encourage the child's functional independence. During the rehabilitation process, the child must be evaluated at designated periods by a multidisciplinary team into which the patient's family is also included. Current research supports the use of functional intervention for children with cerebral palsy. Physical therapy is more valuable rehabilitation treatment to make the children with Cerebral palsy more functional and independent.

KEYWORDS : Cerebral Palsy, Spasticity, Hand function, Neuro-rehabilitation

Introduction

Cerebral Palsy (CP) is a group of permanent, but not unchanging, disorders of movement and posture and of motor function, which are due to a non-progressive interference, lesion, or abnormality of the developing/immature brain. Cerebral palsy is the leading cause of physical disability in childhood with an incidence of 2-2.5 per 1,000 live births. Cerebral palsy is the commonest cause of neurological disability in children. The upper limbs are often affected, with significant wrist and hand involvement from an early age. The severity and type of hand impairments (i.e. motor or sensory impairments) vary widely according to the time of appearance, the location and the degree of cerebral damage. There is therefore a need to quantify hand impairments in the various types of children with CP (i.e. hemi-, di-, and tetra-plegics). Between 30 and 50% of the patients with CP demonstrate sensory disturbances of the fingers. In children with spastic hemiplegia sensory deficits in hands are rather the rule than the exception. But even individuals with CP who have mild motor deficits demonstrate ubiquitous tactile sensory impairments in upper limbs. Tactile sensory impairments can lead to difficulties in grasping, in the selection of finger movements, and in the exploration of objects persisting from infancy, affected children may have abnormal hand postures such as thumb adduction and/or flexion with limited wrist extension, as well as more proximal abnormalities of upper limb tone, posture, and function, which also impact on hand use. About 60% of the children with CP have problems with their arm. Arm-hand skilled performance, i.e. the use of the arm and hand during activities of daily living (ADL), is important to live independently. Hand functioning, the ability of the hands to perform properly in various contexts, requires the integrity of the central nervous system and, therefore, may be disturbed by different brain disorders.

Spasticity is a widespread problem in cerebral palsy as it affects function and can lead to musculoskeletal complications. Children with CP demonstrate poor hand function due to spasticity in the wrist and finger flexors. Thus spasticity in the flexor muscles of the upper limbs poses a great deal of functional limitation in the hands. One common problem associated with poor hand function as a result of spasticity is the inability of the child to grasp objects and difficulty with fine motor tasks such as writing.

The management of upper limbs' problems in CP is often complex and challenging. Effective treatment requires a multidisciplinary approach involving paediatricians, occupational therapists, physiotherapists, orthotists and upper extremity surgeons. Interventions are generally aimed at improving function and cosmoses by spasticity management, preventing contractures and correcting established deformities. Treatment objectives vary according to each child and range from static correction of deformities to ease nursing care, to improvement in dynamic muscle balance to augment hand function.

Current therapy approaches fundamentally comprise repeated practice of desired movements (sometimes including shaping, i.e., breaking down the goal into incremental steps in line with progress), with the child as an active participant. Most activities consider the principles of motor learning and neuroplasticity and are adapted to the age and cognitive ability of the child. Approaches may be play-based, problem-solving, or goal centered, for example, on specific activities of daily living.

TREATMENTS TO IMPROVE HAND FUNCTIONS

CRYOTHERAPY

Ice or cold therapy is a widely used treatment technique in the management of acute and chronic conditions of various types. There are many tissue-based effects which are promoted by the application of cold therapy and these include post-injury reduction of swelling and oedema, an increase in the local circulation, lowering of the acute inflammation that follows tissue damage, muscle spasm reduction, and pain inhibition. Muscle contraction can be facilitated by using cold therapy and this can be used to improve muscle contraction to increase joint ranges of motion after injury. Another effect of cold is a time-related reduction in spasticity once the cold has been applied for some time. Cold can be applied to the body in three different ways: immersing in cold water, rubbing with ice cubes or ice packs or using evaporative sprays such as ethyl chloride.

FUNCTIONAL HAND SPLINT

Functional hand splints are therefore worn during tasks or activities and prescribed to promote optimal functional activities performance via optimal upper limb positioning for task performance. For example, a 'wrist cock-up splint' is designed to stabilize and position the wrist joint during functional activities. Some clinicians treat functional hand splints like 'spectacles' to improve vision, or in this case hand function, whilst being worn. However, other clinicians believe that functional hand splints provide a longer-term training effect and that the gains experienced during splint wearing are eventually generalized and carried over to hand function when the splint is not in use. Insufficient evidence exists to support or refute this accepted wisdom. There is emerging evidence to suggest that functional hand splints may improve goal achievement of functional activities by having an immediate positive effect on upper-limb skills during task performance, although there is limited rigorous evidence available regarding the use of functional hand splints for children with neurological conditions.

TIMP TRAINING PROGRAM

The music used for training was selected based on the preference of the participants, taking the melodic line as the main theme to be played repeatedly with their fingers. In the first half of the training, repeated pressing (finger no. 1-5), sequential playing (ascending 1, 2, 3, 4, 5; descending 5, 4, 3, 2, 1), and simultaneous pressing (1 .2, 1 .3, 1 . 4, 1 .5; 3 .4.5, 4 .5, 3 .5) were measured.

In the second half of the training, extended melody was played in order to maximize the range of motion among the fingers. Warm-up activity with music was applied before the TIMP intervention in order to facilitate relaxation of the gross motor tension. In the initial stage, the TIMP intervention focused on playing fingers individually; however, the treatment transitioned into playing using all of the fingers.

BIMANUAL TRAINING

Impaired function in children with unilateral spastic cerebral palsy (USCP) does not purely result from motor impairments, but is also affected by concomitant sensory impairments. Tactile registration, tactile perception, and sensorimotor integration are essential for grasping and releasing objects, dexterous manipulation, and activities of daily living. There have been studies investigating sensory contribution to motor control in children with USCP . However, whether intensive bimanual training or tactile training is effective in modifying tactile impairments in children with USCP has never been investigated.

Children with unilateral spastic cerebral palsy (USCP) often have tactile impairments. Intensive bimanual training (HABIT) improves the motor abilities, but the effects on the sensory system have not been studied. Here we compare the effects of bimanual training with and without tactile training on tactile impairments.

HABIT is a form of intensive bimanual training for children with USCP using motor learning principles. Children are engaged in using both hands in bimanual play and functional activities. The more-affected hand is treated as the assisting hand (active assist or stabilizer) in the context of task practice. Motor learning principles of whole-task and part-task practice are applied. Clinical trials of HABIT have shown efficacy in improving children's manual dexterity, bimanual hand use, and performance of functional goals.

PEG MOVING TASK

The "Peg Moving Task" was initially proposed by Annett (1985) for the assessment of hand skill in children, and since then the PMT has been widely used to study hand skill development and its relationships with cognitive development in children. We used a reduced 5-hole version of this task, comprised of a wooden board consisting of two rows of five holes. The timer was started when the first peg was raised and stopped when the last peg was inserted. The child had to move each of the five pegs, one by one, to the hole in the opposite row, as fast as possible. The pegboard was placed horizontally and centrally, on a table adapted to each child. After a demonstration by the examiner, the child practiced with each hand, moving the five pegs. The task started with the preferred hand, determined with a hand preference protocol, and each hand performed two trials: one trial from the nearest row to the furthest one, and one trial from the furthest row to the nearest one. For displacements from the nearest to the farthest row, the child began on the left side of the board with the left hand and on the right side with the right hand, while for displacements from the furthest row to the nearest one, the child began on the contralateral side of the involved hand. For the present investigation, only the total time for each hand (i.e., sum of the time needed for the two trials of each hand), noted L and R for left and right hand time respectively, were considered as a measure of hand dexterity (i.e., the shorter the time the greater the dexterity). If a peg fell from the child's hand before being inserted in the opposite hole, and if the child interrupted the movement, the trial was restarted. If a child dropped the peg after inserting it, and if the child changed the order to grasp the pegs or to insert them, there was no interruption in the trial time. All the times measured correspond to uninterrupted trials.

During the task the examiner noted the following, for each of the four trials (two hands, two trials by hand): number of re-starts, which was limited to three, to obtain an uninterrupted trial, and the number of pegs dropped; a failure to remove the peg at once; failure to respect the order, i.e. difficulty choosing the correct peg or the correct hole; difficulty maintaining the peg in the hand; difficulty releasing the peg; use of the other hand to help the active hand; removal of more than one peg at the same time; changes in the hand grip; the type of hand grip (ulnar, palmar, radial-palmar, digital or pincer grasp; later grouped as palmar, digital or pincer grasp); and any intervention of the examiner during the task, such as additional verbal instructions, pointing. Out the correct peg or the correct hole, or maintaining the pegs or the board in place while the other pegs were moved.

ELASTIC TAPING

An approach increasingly being used for the upper limb in neuro-rehabilitation settings but which, to date, has not been adequately evaluated, is the use of elastic taping. This differs from the more rigid forms of "athletic taping" originally developed for sports injuries. Hypoallergenic, waterproof versions of elastic tape are available, as are arrange of colors, which can help in attracting the infant's visual attention (though natural, skin tone colors are sometimes more helpful for infants who tend to remove the tape). Specific manuals and training courses are inexistence and various methods of application have been described, including a "thumb extension assist" approach for the thumb-in-palm deformity. With caution, parents could be trained in application by an appropriately qualified therapist. This is an important consideration because application needs to be repeated frequently (around twice a week).

Many claims have been made regarding the potential benefits of functional elastic taping and these are counterbalanced by both a healthy skepticism and lack of clear evidence of efficacy. One of the more plausible stated mechanisms of action relevant to HCP is through enhancement of cutaneous sensory feedback via stretch applied to the skin during movement. For example, taping for the thumb-in-palm deformity includes a longitudinal strip under tension on the dorsum of the thumb, which could lead to increased firing of cutaneous afferents (mechanoreceptors) on the underlying skin during thumb flexion. This could lead to enhanced proprioceptive feedback. In fact, skin strain patterns in the hand provide kinesthetic information taking precedence over that from muscle spindle and articular afferents in some situations; this kinesthetic role may have been underestimated in the past. Complex interactions at spinal cord level lead to integration of signals from the various proprioceptive afferents , which can then affect muscle spindle sensitivity through modulation of gamma motor neuron firing, and ultimately perhaps alter the balance of muscle activity to strengthen thumb extensors over time .

MOTOR LEARNING THROUGH VIRTUAL REALITY

In this sense, a current possibility for evaluating motor learning is related to interactive computer systems, such as virtual reality (VR). The use of video games with a VR device has been gaining ground in rehabilitation processes. VR refers to a simulated interactive environment. VR aims to create a visual, auditory and sometimes tactile and olfactory environment that appears real and enables the human user to become immersed in the interactive experience. Some authors have reviewed studies on cerebral palsy and VR; Snider et al. carried out a literature review observing the results of VR as a therapeutic modality for children with CP. The research was performed with no time limitation and systematized, using 11 articles for results. They noted a shortage of well-designed studies investigating the benefits of VR therapy in the rehabilitation of children with CP. A relevant point of this study was the difficulty in presenting scientific evidence, mainly because most studies are experimental and observational with small samples. Michelle et al. reviewed VR in pediatric neuro-rehabilitation, using evidence published in the last decade. Thirteen articles were located, among them findings on the use of VR in CP; they also observed that the located studies had small samples and that their levels of scientific significance were low. They suggested that future approaches be performed with more homogeneous groups and standardized methodology, probably through well-designed clinical tests.

CONCLUSION

Although the present study should be regarded as preliminary in light of its limitations, it offers potentially helpful clinical guidelines about the relevant hand skills that should be accounted for when designing hand care interventions, as well as treatment priorities that should be setup to improve hand functioning in children with CP. Hand muscle strengthening and dexterity training may be useful to improve Manual ability in children with CP. However, manual ability is not simply the integration of hand skills in daily activities and should be treated per se, supporting the usefulness of activity based interventions.

REFERENCES

1. Anne Brit Sorsdahl, Rolf Moe Nilssen, Helga K Kaale, Jannike Rieber and Liv Inger Strand. Change in basic motor abilities, quality of movement and everyday activities following intensive, goal-directed, activity-focused physiotherapy in a group setting for children with cerebral palsy. BMC Pediatrics 2010; 10(26):
2. Anant Kumar, Anurupa Senapati. Effect of soft splinting for upper extremity, on manual ability in children with spastic cerebral Palsy. The Indian Journal of Occupational Therapy: 44 (1):30-33.
3. Ahmed M. Azzam. Effect of Hand Function Training on Improvement of Hand Grip Strength in Hemiplegic Cerebral Palsy in Children. Novel Physiotherapies2012; 2(6):2-5.
4. Anna Purna Basu, Janice Pearse, Susan Kelly, Vicki Wisher and Jill Kisler. Early intervention to improve hand function in hemiplegic cerebral palsy. Frontiers in Neurology 2015; 5(281):2-9.
5. Ana Katusica, Sonja Alimovic and Vlatka Mejaski-Bosnjak. The effect of vibration therapy on spasticity and motor function in children with cerebral palsy: A randomized controlled trial. Neuro Rehabilitation (2013); 32:1–8.
6. Carlyne Arnould, Massimo Penta, and Jean-Louis Thonnard. Hand Impairments and their Relationship with Manual ability in Children with Cerebral Palsy. J Rehabil Med 2007; 39: 708-714.
7. Carlyne Arnould,Yannick Bleyenheuft and Jean-LouisThonnard. Hand functioning in children with cerebral palsy. Frontiers in Neurology 2014; 5(48):2-10.
8. Gilberto Nunes , Lucia Willadino Braga , Luciana Rossi , Vera Lucia Lawisch, Luiz Guilherme Nadal Nunes, Georges Dellatolas . Hand skill assessment with a reduced version of the Peg Moving Task (PMT-5) in children: Normative data and application in children with cerebral palsy. Archives of Clinical Neuropsychology (2008); 23: 87-101.
9. Gehan M. Abd El-Maksoud, Moussa A. Sharaf, Soheir S. Rezk-Allah. Efficacy of cold therapy on spasticity and hand function in children with cerebral palsy. Journal of Advanced Research (2011); 2: 319–325.
10. Neeti P. Buddhadev, Bharat Arya. Effectiveness of Play Therapy over Conventional Physiotherapy in Spastic Diplegic Cerebral Palsy Children. NJIRM 2012; 3(2):159-161.
11. Tobias Blumenstein, Ana Alves-Pinto, Varvara Turova, Simon Aschmann, Ines Lützow, and Renée Lampe. Sensory Feedback Training for Improvement of Finger Perception in Cerebral Palsy. Rehabilitation Research and Practice 2015; 1-7.
12. Thais Massetti, et al. Motor learning through virtual reality in cerebral palsy – a literature review. MEDICALEXPRESS 2014; 1(6):302-306.
13. Ryanne JM Lemmens et al., Arm hand skilled performance in cerebral palsy: activity preferences and their movement components. BMC Neurology 2014; 14(52):2-10.