Chapter 4

ICF-CY-Based Physiotherapy Management in Children with Cerebral Palsy

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Additional information is available at the end of the chapter

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Abstract

The immature brain damage causes cerebral palsy (CP) in children, and these children have many disorders of movement and posture development, often accompanied by disturbances of sensation, perception, cognition, communication, and behavior and by epilepsy and secondary musculoskeletal problems. According to the children and youth version of the WHO's classification as *International Classification of* Functioning, *Disability* and *Health*—child and youth (ICF-CY), function can be classified, measured, and influenced in several dimensions. In the treatment of CP, various approaches used are based on different theories of motor learning. Commonly used approaches in the treatment of children with CP are as follows: (1) neurodevelopmental therapy, (2) goal-directed therapy, (3) constraint-induced movement therapy, (4) bimanual intensive manual therapy, (5) treadmill training, (6) muscle strength training, (7) virtual reality, (8) aquatherapy, (9) hippotherapy, (10) family education and home-based treatment.

Keywords: cerebral palsy, ICF-CY, physiotherapy, motor learning

1. Introduction

Cerebral palsy (CP) is a permanent, nonprogressive disorder that occurred in the developing fetus or infant brain, causing deformity in posture and movement development and activity limitation [1, 2].

Movement deformity in CP is characterized clinically with the positive and negative signs of the upper motor neuron syndrome. The positive findings are abnormal phenomena, which occur due to inhibition deficiency emerging in clinical examination frequently. The positive findings are spasticity, dyskinesia, hyperreflexia, delayed developmental reactions, and secondary muscle-skeletal malformations. The negative findings are disability reflecting deficiency or the absence of development of sensory-motor control mechanisms, decrease in movement coordination, and weak balance and walking ability [3–5].

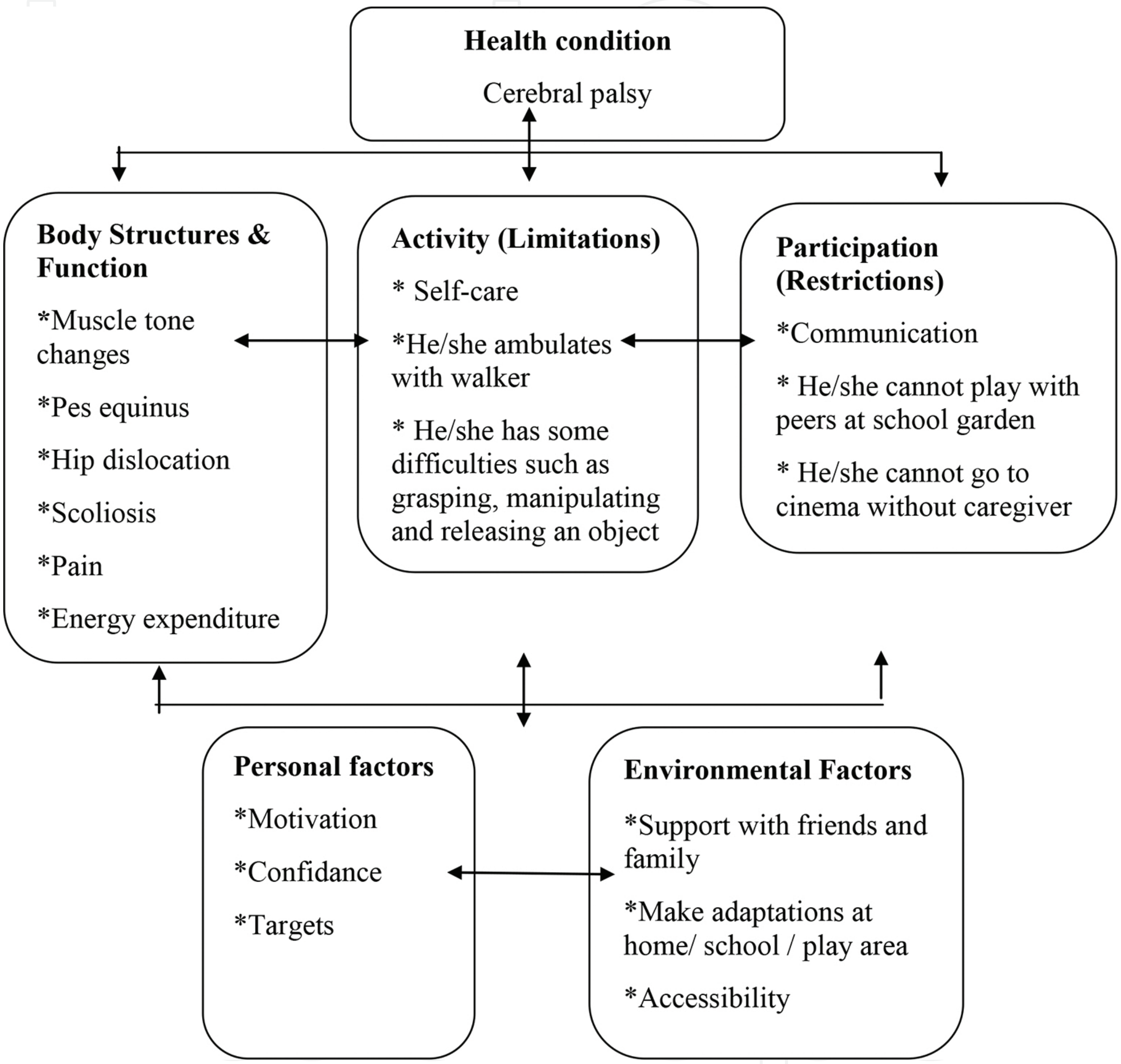

Table 1. ICF-CY three for cerebral palsy.

The World Health Organization's (WHO's) *International Classification of Functioning, Disability, and Health* (ICF), including its *Children and Youth* version (CY), established specifically to determine health state of children and youngsters and consisting of 1685 categories, is a considerably wide-scale coding system [6]. ICF-CY is a biopsychosocial model that emphasizes human functioning (body functions and structures, activities, and participation) as a result of the interaction between health conditions (diseases or diagnoses) and contextual factors [classified and coded as environmental (e) and personal factors] [6]. General definitions used in ICF-CY are as follows:

- Body functions are physiologic functions of body systems.
- Body structures are anatomic parts such as organs and limbs of the body.
- Impairment is the problems and deviations in body structures and functions and losses of functions.
- Activity is doing a movement or task by the individual.
- Participation is to be within life.
- Activity limitation is the difficulty during activities in the life of the individual.
- Restriction in participation is the problems that an individual may encounter in life.
- Environmental factors make up the physical, social, and mental factors in the environment of the individual [6].

In recent years, ICF-CY is a guide used prevalently in both the evaluation of children and the determination of a treatment program. The impairments observed in CP according to ICF-CY are outlined in **Table 1**. The therapeutic approaches used in CP treatment on the base of ICF-CY are summarized above.

2. Neuro-developmental therapy

Neuro-developmental therapy (NDT) or Bobath therapy is one of the prevalently used therapeutic approaches established by Berta and Karel Bobath in 1940s [7]. Developments in Bobath approach have continued since 1940 until today and now are a “living concept” rather than a technique [8]. This concept consists of specific theories improved by experiences, and these theories have been developed until today by preserving their dynamics along with various changes [9]. Recently, Bobath concept is congruent with the ICF-CY, acknowledging the entirety of human functioning in all spheres of life, as well as the individual nature of each problems. Activity limitations are regarded as the outcome of a complex relationship between the individual's health condition, personal factors, and the external factors of the environmental circumstances in which the individual lives. The structure provided by the ICF-CY has moved the focus of clinicians beyond interventions that are only impairments directed toward enabling the individual to overcome activity and participation restrictions. Participation restrictions are identified in consultation with the individual, the family, and relevant caregivers. The functional goals that are set are those that are relevant and achievable for the individual [10].

The concept comprises three fundamental rules as facilitation, communication, and stimulation to ensure normal postural experiences, reduce motor sensory impairments, and to improve functional independency level in children with CP. Handling techniques that control various sensory inputs are used, to regulate abnormal tonus, reflexes, and movement patterns and at the same time to facilitate muscle tonus, balance, and normal movement patterns [11, 12]. Functions that cannot be carried out by children due to spasticity or muscle fluctuation are determined and personal target analysis is made. Tonus regulation is ensured by positioning. Active movements are revealed by stimulations improving sensorimotor activity [10, 13]. Numerous modifications can be made in treatment since NDT is a "living concept."

The Bobath concept strives toward a 24-h interdisciplinary management approach. When the individual, family, all professionals, and other caregivers have insight into the problems and work together for the same goals, these goals are usually accomplished. Motivation and the therapeutic relationship between the clinician, the patient, and their family and/or caregivers are recognized as essential aspects for successful rehabilitation. The holistic approach to intervention is integral to the Bobath concept. The Bobath concept is an interactive problem-solving approach. Reassessment is ongoing with attention to individual goals, development of working hypotheses, treatment plans, and relevant objective measures to evaluate interventions. Intervention strategies are unique to the individual [10].

When the researches in the literature are considered, Weindling et al. [14] compared the NDT with standard care applications in their study conducted on 87 infants and showed that there were similar results in both groups. Mayo et al. [15] applied NDT to 17 infants diagnosed with CP one time a week, and the other 12 infants one time a month for 6 months. In conclusion, it was found that intensive NDT application showed better motor development. Palmer et al. [16] applied an "infant stimulation program" consisting of family-based motor, sense, language, and cognitive activities for a year to spastic infants with CP in the age range of 12 to 19 months old. Franki et al. showed in their systematic review that NDT's effects were arranged on their evidence levels according to ICF, and NDT is a method for improving gross motor function level, and activity, and participation level. It was reported that functionality was ensured by the regulation of muscle tonus and muscle length enabled by NDT [13].

Although NDT is the most prevalently used treatment by physiotherapists in Northern America, there is not sufficient evidence to support its effects [17, 18]. It is very difficult to compare it with other applications because of the modifications made in the original method generally [19].

Summary

Neuro-developmental therapy is summarized as follows:

- NDT is an interactive problem-solving approach.
- NDT strives toward a 24-h interdisciplinary management approach.
- NDT improves motor performance, especially gross motor skill, postural control, and stability.
- NDT can be effective in each parameter of ICF-CY.

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3. Goal-directed therapy

Goal-directed therapy (GDT) consists of recovery based on brain plasticity after brain lesion depending on motor learning, motor control, biomechanics, muscle physiology, and activity. It is used recently in the pediatric rehabilitation field frequently. In this application, functional activity is organized according to the behavioral goals instead of isolated reflexes or motor patterns according to the theory of dynamic system of motor control. The therapists ensure active participation of children and attempt to change environmental limitations by various means in order to assist the solution of motor deficit in the central nervous system (CNS) [20].

One of the major problems in CP is the abnormal programming of movement. GDT is an application aiming smooth programming of movement according to motor learning principles. According to the assessment of ICF-CY, ensuring of maximum independency and functionality of children is aimed by the goals determined for activity limitation and participation constraint [21]. The therapy focuses on active participation to improve functional independency and performance instead of elimination of deficits [22].

In the literature, it is reported that very effective gain can be achieved in personal functional goals and gross motor function by the goal arrangements specific to person as a result of the goal-oriented and functional applications. Numerous individual goals are defined according to the activity level. In short term, especially measurable, specific therapy goals are effective in the motivation of therapists, family, and children [23]. It was shown that there was significant change in the participation level of children with CP by goal-oriented training [24]. The families expressed that they were satisfied with the therapy and goal-determination process and this situation created positive effect on the surrounding of the children [25].

Summary

Goal-directed therapy is summarized as follows:

- GDT is applied according to motor-learning principle.
- The goals must be specific to individuals and measurable.
- Goal-oriented active participation and environmental arrangement is crucial.
- GDT is effective in each level of ICF-CY.

4. Constraint-induced movement therapy

Constraint-induced movement therapy (CIMT) is a rehabilitation technique developed by Edward Taub [26] supporting “repetitive” use of the upper limbs in hemiparetic patients. Initial studies were conducted on monkeys who were made to develop somatosensorial deafferentation by preventing somatic sensory modulation in the upper limbs. Following somatosensorial deafferentation, “learned nonuse” idea was introduced when the monkeys were not able to use their arms effected in the free setting. CIMT approach was initially used in adult hemiparetic patients and it is limited healthy upper limbs or slightly affected upper limbs for breaking "learned nonuse" pattern [27]. The following three key components are used to improve usage of the affected upper limbs in CIMT:

- Constraining healthy upper limb movements
- Intense practice
- Shaping of behavior

The application showed successful results in adults, and subsequently, it was used in children with hemiparetic CP as well. As different from adults, CIMT is applied in the framework of motor learning rules in the earliest term in hemiplegic children because the right movement was never learned [28]. Children with hemiplegic CP may have sensorial problems as well such as asterognosis with the effection of the areas related with the pyrimidal system, talamocortical ways, somatosensorial areas, and sensorial integration [29]. The purpose of CIMT approach is to prevent the ignorance of the affected side, learned nonuse, and poor plasticity. It is desired in the studies in general that children's cognitive level is good, 20° of extension in the effect side wrist is achieved, and there is the skill to be able to release an object from their hands [28, 30]. According to ICF-CY, CIMT promotes functional changes that permit children with hemiplegic CP to increase their participation in various tasks outside of therapy and by improving the ability to perform upper limb tasks in a lasting way. Intervention in a natural setting accounts for the importance of the individual's environment and might facilitate the transfer of any learned skills into daily functioning.

The original program consists of a 6-h training a day for 3 weeks for low-function patients [31]. Today, the application has been modified in various forms according to the constraint period, materials used for constraint purpose, and application setting. Constraint form of the healthy limb in children can be ensured by casts, braces, orthesis, slings, or gloves [28]. Constraint duration varies from 30 min to 6 h according to the children's age and adaptation. CIMT approach can be applied as a daily therapy session, weekly camp model, or house-based therapy session [32]. An enriched environment and active motor training are crucial again [33]. CIMT effectiveness was shown at the age range of 7 months and 30 years old; however, there is no evidence yet for the effectiveness of early physiotherapy. There was no difference found in the developments following CIMT application of the same intensity in children of 4–8 years of old and 9–13 years of old [28]. By the daily camp model of Thompson et al., modified CIMP was applied to six children with hemiparetic CP and progress was achieved in hand skills, personal care, and social functions of the children [34]. Chen et al. reported better motor control changes induced by a home-based CIMT program compared with a dose-matched clinic-based traditional therapy, which included neuro-developmental treatment techniques and unilateral and bilateral activity-oriented training [35]. A randomized controlled trial investigated the same modified regimen of CIMT in two groups. The only differences arose from the randomization to either the home-based therapeutic environment, where the children had the opportunity to engage in real-life conditions using their own toys, or the clinic-based environment. The findings revealed greater improvements in the home-based group [36].

Summary

CIMT is summarized as follows:

- Three key components of CIMT are the constraint of healthy hand movement, intense practice, and behavior shaping.
- CIMT application may be modified according to age, motivation of child, duration of exercise, environmental setting, and constraint devices.
- CIMT is effective on all parameters of the ICF-CY.

5. Bimanual intensive manual therapy

One of the task-oriented therapies in children with hemiparetic CP is intense bimanual therapy (BIMT). Bimanual activities are difficult for hemiplegic children [37]. In bimanual activities, whereas one of the hands is stabilized normally, the dominant hand is engaged in more active procedures, and the children with hemiplegic CP develop compensatory single hand strategies (e.g., they achieve stabilization of an object by using their mouths and knees) by using other parts of the body because they cannot use their affected hand sufficiently for support [29]. This application is an approach used according to motor learning principles in children with hemiplegic CP. The purpose is to improve usage quality and characteristics bimanually. Furthermore, performance is more important. Both hands are used actively [38]. Active fine-gross motor movements according to the age and functional level of children are determined. First, active movements are shown with the healthy limb and the activities are repeated with the affected side. Difficulty and speed of the task is graded [39]. The upper extremity, which is used as a stabilizator at the beginning, is moved for more difficult manipulative skills over time. In the study of Gordon et al. comparing BIMT and CIMT applications, CIMT was found to be more effective in solving the impairment, and BIMT was found to be more effective in bimanual motor coordination and planning. Moreover, it was reported that a 90-h BIMT application was more effective in comparison to a 60-h application. Studies on the therapy frequencies are still ongoing [37].

Summary

BIMT is summarized as follows:

- BIMT aims the quality bilateral upper extremity use.
- It is applied according to motor learning principles.
- It is more motivating and child-friendly because it is not a constraining material.

6. Treadmill training

Treadmill training is a method encompassing motor learning and motor control theories and used for improving postural control in children because it is based on repetition and practice

[40]. Walking limitations are faced frequently in CP. Reduced walking speed and endurance are the two fundamental problems [41]. Walking is with rhytmic steps and repeating patterns in treadmill training, and this improves harmonization between agonist and antagonist muscles and ensures the development of dynamic and static balance. The conducted studies illustrated that positive progress was achieved in gross motor function and gaiting with the treadmill training [40, 42].

In a systematic review conducted by Willoughby et al, the effects of treadmill training are as follows:

- *Effects on gross motor function*: Significant improvement was achieved in the gross motor function measure (GMFM)'s D (standing) and E (walking, running, jumping) and total score sections.
- *Efects on body structure and function*: Energy spent during walking was assessed and significant change in energy expenditure index (EEI) was observed. There was no significant change observed as a result of the evaluation of muscle tonus and selective motor control.
- *Effects on social participation*: The effects on social participation in children with CP have not been evaluated in any of the studies.
- *Adverse event*: Treadmill training was tolerated by all participants and there was no unexpected situation faced. There was no injury during or after the training due to any muscle spasm and joint ache or falling [43].

Treadmill training can be used in children with CP at any level of GMFCS. Based on the functional level of children, speed (range 0.25–5 km/h or as fast as possible), training period (and duration (10–30 min) and support amount provided to the children (Body weight support treadmill training (BWSTT) and partial body-weight support treadmill training (PBWSTT)) can change [44].

Body-weight support treadmill training (BWSTT) ensures stepping, endurance, and strengthening training in adults by reducing body weight. It is used less frequently in children. Following the declaration of the effects of early gaiting training in children with CP by Richard et al in 1997 [45], studies using BWSTT in children with CP have increased. It was reported that BWSTT could ensure positive improvement in gross motor function and walking speed; however, further randomized controlled studies were needed [46].

Partial body-weight support treadmill training (PBWSTT) allows the therapist systematically to train patients to walk on a treadmill at increasing speeds with increasing weight bearing, and simulating what will be necessary for household or community ambulation for GMFCS level IV and V children. PBWSTT intervention is also potentially attractive as it may address gait limitations more effectively, because it allows gait to be addressed at multiple levels of ICF-CY. Interest in PBWSTT for children with CP is rapidly increasing. Evidence to support treatment intervention in children with CP should be carefully explored by clinicians before they add it to their treatment repertoires.

In the literature, it was reported that improvement could be achieved in self-selected walking speed and gross motor function by PBWSTT in children with CP [47, 48].

Summary

Treadmill training is summarized as follows:

- Treadmill training is appropriate for children in any GMFCS levels.
- The speed is generally 0.25–5 km/h and duration is 10–30 min.
- It has positive effects on body structure and function in comparison to ICF-CY.

7. Muscle strength training

Muscular weakness presents a serious problem for children with CP [49]. In the past, strengthening training was avoided with the notion that it would increase spasticity and reduce range of motion (ROM) and cause gaiting problems in children with CP. It was shown in the conducted systematic reviews that strengthening training is effective in muscle strengthening without any negative effect [50]. Resistive training improves muscular force and muscular volume, and this force can be transferred to the functional development [2, 51]. Progressive resistance exercise (PRE) is a strengthening training method where intensity is increased over time. It stimulates strength gain more in comparison to normal development and growth. Fundamental principles of PRE can complete small repetitions with an effective resistance without the creation of exhaustion in a set. According to the National Strength and Conditioning Association (NSCA), the principles of the strengthening training in youngsters are outlined as follows:

- Ensuring quality training and supervision.
- Make sure that the exercise setting is safe and free of danger.
- Start to each exercise session with a 5–10 min dynamic warming period.
- Start with rather light loads and focus on the right exercise technique always.
- Do the various upper and lower extremity strengthening exercises with 6–15 repetition and as 1–3 sets.
- It must consist of special exercises to strengthen abdominal and back regions.
- Focus on the development of symmetrical muscles around the joints and on appropriate muscular balance.
- Apply various upper and lower extremities force exercises with 3–6 repetitions and as 1–3 sets.
- Advance in the training program based on need, goal, and skills.
- Increase the resistance gradually (5–10%) as the force increases.
- Cool down with calistenic and static stretch exercises.
- Listen to personal needs and anxieties in each session.

- Start the endurance training 2–3 times a week in nonconsecutive days.
- Use personal loading to observe the progress.
- Keep the program fresh and make systematic changes in the training program.
- Make the performance suitable and compose with healthy nutrition, adequate hydration, and proper sleep.
- Support and encouragement by the family and trainer will help increase in interest [52].

Although the duration and arrangement of PRE training in children with CP is still contradictive, the selection of candidate and exercise contributes to the improvement of daily functions in various degrees including gross motor function and gait quality. It was illustrated that PRE created muscular force without generating harmful effects, such as hypertonia, and improved children's skills [53].

In the review of Verschuren et al, it was reported that before starting strengthening exercises in children with CP, there must be an exercise "adaption period" for 2–4 weeks, two times a week, and for this, starting with low dose (with short duration, less intense, consisting of a single joint) exercises than the duration and intensity of exercises are increased as the adaptation of the children improves and can be started multiple joints exercises.

The strengthening training suggested for children with CP is as follows:

- *Frequency*: 2–4 times a week in nonconsecutive days
- *Intensity:* in 50–85% of maximum repetition, 6–15 repeats, 1–3 sets
- *Duration:* the period of a special training has not been defined for an effect. The training period must be at least in consecutive 12–16 weeks.
- *Type:* initially single joint, machine-based exercises must be started and then, multijoint endurance exercises must follow with the machines plus free weight (closed kinetic chain). Single-joint endurance training at the beginning of the training may be more effective for very weak muscles in children [54].

In the pilot study of Blundell et al conducted on a small group of children with CP at the ages of 4–8 years old, 47% force increase was achieved in the children with PRE training applied by using gymnastics equipments, including treadmill and leg press as a group training 2 days a week for 4 weeks, and this effect continued for 8 weeks following the application [55].

In the study of Ault et al, low-dose community-based strengthening training was applied in children with CP, and at the end of the study, in addition to the functional force activities, significant gain was achieved in protective postural adjustment, static stability limit, and dynamic balance. It was indicated that low-dose exercises can be effective as well without a need for expensive equipment [53].

As a result of the strengthening training of Bania et al applied for 12 weeks 2 days a week accompanied with physiotherapists in sports hall in children with bilateral spastic CP, it was reported that force increase was achieved in the lower extremity muscles; however, there was no significant change in daily physical activity. Whereas improvement was achieved in body functions in the scope of ICF-CY, activity, and participation was not affected [56]. In the systematic review of Franki et al, the strengthening training showed changes in body structure and functions such as decrease in energy consumption, increase in muscle volume, improvement in body image perception in comparison to ICF-CY. An increase in gait and gross motor function and development in activity was reported. There was no effect of strengthening training on participation found in the articles [44].

In a review, the effect of the upper extremity strengthening training in children with CP, it was indicated that there was no adequate randomized controlled studies, in addition to the strengthening training, goal-oriented therapy, electric stimulation, and botulinum toxin applications were conducted. According to NSCA's criteria, resistance exercises were suggested for at least 12 weeks three times a week, with 8–15 repetition. The effect on activity and participation was not evaluated in any of the studies [57].

Summary

Muscle strength training is summarized as follows:

- The strengthening training in children with CP improves the force and muscle volume without any adverse effect.
- PRE training is applied at least 3 days a week with 8–12 repetition, 1–3 sets and for 8–20 weeks for each muscle.
- The muscle force achieved by PRE training must be transferred to functional activities.

8. Virtual reality

Virtual reality (VR) systems ensure opportunity for children with CP to do performance activities that they cannot do in his/her natural environment by establishing an interactive and motivating setting. These systems provide feedback to the player in virtual world and the child can observe their own movements. VR improves motor skills with repetitive practices oriented to the goal in children with CP due to its characteristics, including task separation between the real world and virtual environment, with flexible therapy parameters specific to the person, visual and audial feedback, social game equality during game, neuroplastic changes, problem solving in different virtual situations, motivation of the children in game selection and completion, and undertaking a supportive role in verbal encouragement and feedback. All of these parameters are required for motor learning and improvement of motor skills [58, 59]. Modifications can be made in exercise dose (duration, frequency, intensity).

Movement-based interactive video games (IVO): Nintendo Wii and Microsoft's Kinect movement sensors are the new treatment methods for children with CP. They improve arm movements, functional status, daily life activities, and balance of children [60–62]. In the study of Luna Oliva et al [63], balance and daily life activities of children with CP who were treated for 8 weeks with Xbox 360 Kinect ™ (Microsoft) improved. Positive developments were determined following therapy in gross motor functions, balance, gait speed, running and jumping, daily life activities, and fine motor skills of children. Although IVO is used as a treatment method in many studies, it can also be used as an evaluation method. Kinect 360 Xbox sensor provides information about the speed, acceleration, and distance of movement [63]. In the study of Jelsma et al. conducted on children with hemiparetic cerebrals palsy, it was revealed that Nintendo Wii Fit game is effective in balance training [64].

It was reported that virtual reality systems were effective and used in the fields including upper limb (quality of the movement, active movement control and coordination of upper limb motor performance), lower limb (ankle kinematics, gait, functional performance), postural control (active control of pelvis and trunk, increased balance and selective control), and physical-cardiovascular fitness (great potential to promote increased physical activity and enhanced cardiovascular fitness) [65].

In the systematic review of Glegg et al, it was stated that there were scarce randomized controlled studies showing the effect of VR systems. The studies in the scope of ICF-CY showed that they generally evaluated functional balance and mobility, upper limbs, cognition, fitness, daily life activities, and living skills at home and in society and that VR systems were effective on body functions, activity, and participation.

Summary

Virtual reality is summarized as follows:

- VR systems encourage the child with funny and enjoyable play settings and increase child's motivation.
- The interactive games support motor learning and cortical plasticity.
- VR presents an opportunity to promote physical fitness and decrease sedentary behavior.

9. Aquatherapy

Aquatic exercises are performed within water by benefiting from various characteristics of water. Aquatherapy (AT) is an intervention applied with the assistance of an experienced therapist to benefit from mechanical characteristics of water. It is an application made of various activities selected specifically according to the problem of the participant and determined according to task-oriented motor learning principles [66, 67]. Although the term "aquatherapy" is used prevalently, many different terms are used as well including aquatic exercise therapy, aquatic rehabilitation, pool therapy, and hydrotherapy [68–70].

Children with CP can easily do many activities in water requiring movement control against gravity such as walking that they cannot do on land owing to physical and mechanical characteristics of water. Water gives a chance to the children to feel independent and improves their self-confidence and self-respect [71]. Movements within water are displayed with more control and slowly, and therefore, they ensure realization of postural reactions and required adjustments [72]. They can do the abnormally displayed movement patterns on land more smoothly in water. Mental awareness and focusing enhances in children who receive intense sense input with thermoregulation, waves, turbulence, viscosity, stretching force, and texture of water. Approaches in water can also be applied as a group activity in children whose motor functions and mental levels are in harmony with each other [73]. Doing activities in an entertaining and social setting for children also supports participation [74]. In the study of Brunton et al conducted on children with CP, exercise and activity participations of children according to their gross motor function levels (GMFCS I-V) were investigated. It was reported as a result of the study that children with good motor function level (I–III) preferred first walking activity and then swimming activity; children with low level (IV–V) preferred walking activity first [75]). In the scope of ICF-CY, it is crucial to enhance activity and participation of children with neuromotor problems, and in this respect, water provides a suitable setting [76]. When the studies in the literature are considered, the treatment frequency and duration is 20–40 min a day for 2–5 days a week and at least 14–16 weeks in total [77]. A lifting system within pool can be constructed for participants whose function level is low.

Aquatherapy is concerned with all parameters under ICF-CY frame. Halliwick technique is an efficient approach for children who cannot do activities due to insufficiencies in their body structure and functions and whose social participation is constrained [66, 77]. This approach, requiring active participation, ensures the children to do many processes that they cannot do on land, within water, and receiving a group training along with children at their own motor function level increases their social participation [73, 78]. High motivation of children within water, which is an entertaining environment, affects their motor-learning process [70, 79]. Furthermore, satisfaction of the children and families provides positive feedbacks as personal and environmental factors [80]. Dimitrijevic investigated the effect of techniques in water on gross motor function and skills in water in children with CP. A therapy protocol was applied made up of 10-min warm up, 40-min swimming, and 5-min game activities for 6 weeks (55 min/2 sessions/week) to the children. Motor function skills improved significantly in water and on land in AT group [81]. Getz et al. examined the effect of AT on motor performance and metabolic consumption during walking in children with early-stage spastic diplegic CP. It was observed that AT reduced metabolic consumption during walking at the end of a 16-week program. While oxygen consumption value was conserved, walking speed increased during submaximal exercise [82]. Gorter evaluated aquatic exercise programs in the scope of ICF-CY in a review conducted on adolescent children with CP. It was reported that AT participation was constrained in children who are influenced strongly by personal and environmental factors (barriers) including fear and transportation problems. Progress was observed in walking and running activities, balance skills, energy consumption indexes, muscular forces, and performance tests [83].

Summary

Aquatherapy is summarized as follows:

- Thermoregulation, waves, turbulence, viscosity, lifting force, and water texture is used as therapeutics in AT.

- AT is related with all parameters under the ICF-CY.
- The frequency of treatment is 20–40 min/daily, 2–5 day/week and between 14–16 weeks.

10. Hippotherapy

Hippotherapy (HT) is an approach used highly by physiotherapy, occupational therapy, and speech therapists to ensure motor and sensorial stimulus in children who need therapy. Typical characteristics are benefited including rhythmic movements and body heat of horse for the therapy purpose [84]. In therapeutic horse riding, the purpose is based on teaching of horse riding and control skills, and HT is completely a treatment strategy and is used in neurodevelopmental disorders including cerebral palsy and autism and in the treatment of adult patients who have neurologic disorder [85]. HT practitioner is called hippotherapist. Within HT sessions, there must be a therapeutic horse, patient, “puller” directing the horse, “side walker” responsible for patient safety, and a hippotherapist responsible for execution of the session with all of these people [86]. HT can continue for 30 min–1 h a day, 1–2 sessions a week, and for 12–18 weeks in total [87].

According to body structure and function dimension of ICF-CY, it decreased muscle tone and improved trunk and pelvic posture and stability and child behavior. On activities, significant improvements on upper and lower limb gross motor function was reported [44, 88].

Summary

HT is summarized as follows:

- HT can be used as an addition to all treatments to develop posture and postural control.
- The intensity of treatment is approximately 30 min–1 h/day, duration of HT is 1–2 day/week during 12–18 weeks.

11. Family education and home-based treatment

Family is at the center of treatment in all treatment methods for children with CP. In addition to have the children do home exercises who spend large portion of the day within home setting, it is crucial that children are observed during life activities, including personal care, mobility and sleep, and appropriate adaptations, are provided to protect their body structures, and functionality is continued [89].

Family education principles acknowledge that families are different and unique, and optimal child functioning occurs within a supportive family and community context and that parents know their children best with the therapist viewed as a collaborator, not as an expert. Goals of treatment are identified collaboratively with input from the family, child, and therapist. There is evidence to indicate that family education leads to improved outcomes for children and families as well as greater satisfaction for families leading to increased adherence to treatment recommendations and to improved well-being and fewer parental feelings of distress and depression [90].

The Coping with and Caring for Infants with Special Needs (COPCA) Program is a treatment method aiming activity and participation in children with CP by teaching home exercises to families and routine monitoring. The center of COPCA is family. Therefore, family autonomy, family responsibility, and family-specific parenthood are the fundamental components of COPCA. Family autonomy shows the criteria of family for living quality. Family responsibility reflects the selections and decisions of family about child care and the interaction of health professionals. Family-specific parenthood illustrates the child training form of caregiver for the child to have responsibility and be independent. The purpose of COPCA program is to encourage families to solve daily care problems that are observed naturally during parenthood by using their own capacity. "Coaching" is used to reach this goal. Coaching is the fundamental strategy of COPCA. The coaches (physiotherapists) do not tell the families what they can do or what they should do but they help families discover applications that can be carried out. Physiotherapists listen to families, make observations and suggestions, and inform and support them. Families are the persons who have major responsibility to make decisions about the child care and treatment with the help of the physiotherapist.

In the study of Dirks et al, it was illustrated that the infants showed development in supine, prone, and sitting positions according to the results of the evaluations performed in month 4 and 6 in risky infants who were treated by using COPCA method. In addition to the progress in the development of the children, there were positive developments in activity in the scope of ICF-CY [91].

The following conditions must be considered for a home program to be effective:

- Parents must be in collaboration and know the child and child's home setting well.
- Children and families must determine which work they want to do in home setting and select a goal accordingly.
- Selection of home program among evidence-based applications, selection of the purposes according to family life, and changing them according to the preferences of children
- Providing regular support to the families to define the development of the children and to determine the things to be added to the program
- Evaluation of the results together.

Summary

Family education and home-based treatment is summarized as follows:

- Family is in the center of the treatment.
- Family education leads to improved outcomes for children and families as well as greater satisfaction for families leading to increased adherence to all kinds of therapeutic treatments.
- Family should be supported by physiotherapists for the application of the home program.

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