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Rehabilitation of children with cerebral palsy from a physiotherapist's perspective

Fizyoterapist bakış açısıyla beyin felçli çocukların rehabilitasyonu

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Pediatric rehabilitation requires a multidisciplinary team approach to disabilities or handicaps caused by physical, mental, sensory-perceptional, or cognitive disorders due to prenatal, natal, or postnatal causes. Cerebral palsy (CP) is defined as persistent but not progressive disorder of posture and movement system, associated with functional activity limitations and sensorial, cognitive, communication problems, epilepsy, and musculoskeletal system problems. Physiotherapy approaches in rehabilitation applications aim to normalize sensorial and motor functions, provide normal posture and independent functional activity, regulate muscle tone, improve visual and auditory reactions, support normal motor development and motor control, improve ambulation and endurance, increase the quality of the existing movements, prevent soft tissue, joint and postural disorders, support orthopedic and surgical procedures, and finally to prepare the child for the adolescent and adult periods. Setting realistic goals, determination of the priorities, informing the family and enhancing family participation in physiotherapy programs will increase the success of physiotherapy. This article reviews current rehabilitation approaches and physiotherapy applications for children with CP.

Key words: Cerebral palsy/rehabilitation; child; disability evaluation; exercise therapy; muscle, skeletal; physical therapy modalities; range of motion, articular.

Çocuk rehabilitasyonu, doğum öncesi, doğumda ya da doğum sonrası nedenlerle oluşabilen fiziksel, zihinsel, duyu-algı ya da bilişsel bozuklukların yarattığı özür ya da engel tablosuna ekip yaklaşımını gerektirir. Beyin felci (BF), fonksiyonel aktivitelerde kısıtlılıklara neden olan, postür ve hareket sistemindeki ilerleyici olmayan, kalıcı bozukluk olarak tanımlanabilir; bu tabloya duyu, algı ve iletişim sorunları, epilepsi ve kas-iskelet sistemi sorunları da eşlik edebilmektedir. Rehabilitasyon uygulamaları içinde fizyoterapi yaklaşımları, duyusal ve motor deneyimleri normalleştirmek, düzgün postür ve bağımsız fonksiyonel aktiviteyi sağlamak, kas tonusunu düzenlemeye çalışmak, görsel ve işitsel reaksiyonları geliştirmek, normal motor gelişimi desteklemek ve motor kontrolü sağlamak, var olan hareketin kalitesini artırmak, yürümeyi geliştirmek, oluşabilecek yumuşak doku, eklem ve postür bozukluklarını önlemeye çalışmak, ortopedik ve cerrahi girişimleri desteklemek ve sonuçta çocuğu gençlik ve yetişkin dönemlerine hazırlamak gibi genel amaçları taşır. Gerçekçi hedefler ve önceliklerin belirlenmesi, ailenin bilgilendirilmesi ve fizyoterapi programına aktif katılımının sağlanması fizyoterapinin başarısını artıracaktır. Bu derlemede BF'li çocuklarda güncel rehabiltasyon yaklaşımları ve fizyoterapi uygulamaları incelenmeye çalışılmıştır.

Anahtar sözcükler: Beyin felci/rehabilitasyon; çocuk; özürlülük değerlendirmesi; egzersiz tedavisi; kas, iskelet; fizik tedavi uygulamaları; hareket açıklığı, eklem.

Pediatric rehabilitation is defined to improve the independence level of a disabled child functionally and psychologically, in the physiological, anatomic, and environmental restrictions and to increase the quality of life of children and their families.[1] Rehabilitation process requires several disciplines to come together. In this process, inter- and intradisciplinary communication is a necessity and every discipline should act according to the needs of the child and family.[2-4]

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The World Health Organization (WHO) estimated the disability ratio in developing countries as 12%. It has been reported that 6 million disabled people live in Turkey. In our country, there are 25 million children in the 0-18 age group, of which 3 million are disabled children between 0-16 years of age.[5] In terms of quality of life and deficiency, rehabilitation targets should be determined exactly, problems identified, the outcomes interpreted, and regular follow-ups questioned.[6]

In our opinion, rehabilitation terms about children have quite various definitions in Turkey, which should be clearly defined in order to establish proper approaches. The use of terms in accordance with the accepted situation of children is quite as much important as established medical definitions. The definitions that are used or ought to be used in our country should be generated through interdisciplinary collaboration and taking the opinions of the handicapped children and their families.

If we define impairment, disability, and handicap as to the problems of disabled children; impairment defines the primary lesion and pathology, such as the problem with the brain that causes spasticity, and includes the direct effects of spasticity, such as a dislocated hip caused by the spastic muscles;[7] disability is used to express loss of function that an individual experiences because of impairment; therefore, the inability to walk or sit well is a disability arising from the impairment.[8] Handicap is the result of limitations imposed by the environment and society, which limits an individual having a specific disability.[9]

Another significant classification that has been put forward in recent years is the International Classification of Functioning, Disability and Health (ICF).[10] For rehabilitation professionals, the complex relationship between disability, participation, and environment represents an area of specific importance for children. The revised version of the ICF incorporates biological and social perspectives on disablement, so as to represent fully the impact of health on a person's life, including participation in the community. Physical, social, and environmental factors, service systems and policies may influence a person's attitude to his/her impairment or activity limitations.[11]

Cerebral palsy

Cerebral palsy (CP) refers to a group of permanent disorders of the development of movement and posture, causing activity limitations, that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain.[8] The motor disorders of CP are often accompanied by disturbances of sensation, perception, cognition, communication, and behavior, with epilepsy, and with secondary musculoskeletal problems.[12] The estimated prevalence in the general population is 2/1000.[13] The limitations in activity require individual rehabilitation throughout life.[14] Impaired control and coordination of voluntary muscles is accompanied by mental retardation or learning disabilities in 50 to 75% of children and by speech disorders (25%), auditory impairments (25%), seizure disorders (25-35%), or abnormalities of vision (40-50%).[14]

In Turkey, the prevalence of CP is higher than most developed countries. Various reasons to explain this include poor perinatal care, high rates of postnatal maternal diseases and infections, malnutrition, and a high rate (25%) of consanguineous marriages.[15] This latter factor is increasing and causes, predictably, higher numbers of children born with recessive conditions, many of which have associated disabilities.[16] In our previous study on rare disorders, we found that 90 (40%) of 226 had first-degree, and 27 (12%) had second-degree consanguineous marriage.[17] The prevalence of CP in Turkey is 4.4/1,000 live births.[18]

Damage to the central nervous system cause disorders in neuromuscular, musculoskeletal, and sensorial systems.[19] These disorders result in posture and movement deficiencies. Functional independence levels of these children are affected negatively due to secondary disorders such as various musculoskeletal deformations and tertiary disorders due to different compensation mechanisms that develop over time. Although the damage is not progressive, manifestations of deficiency and disability may be progressive.[6,14,20]

Finally, CP occurs as a developmental disorder.[8,21] The main problem in all types of CP is motor disorders accompanied by sensorial and cognitive problems.[1,7,22] The causes of motor disorders are developmental retardation, abnormal muscle tone, muscle weakness, postural control deficiencies, sensorial problems, behavioral problems, orthopedic problems, abnormal movement patterns and reflex activity, asymmetry and deformities.[3,6,13,23] The functions that a child with CP should gain following motor developmental milestones are delayed related to the severity of the lesion. The persistence of primitive

reflexes which should have been inhibited in the normal developmental process prevents the development of correction and equilibrium reactions.[24]

Rehabilitation

Rehabilitation approaches to children with CP are comprehensive. In addition to medical and surgical applications, physiotherapy, occupational therapy, speech therapy, orthosis and other adaptive equipment, recreational activities, school and education adaptation and psychosocial support are included in rehabilitation approaches.[25]

The aims of rehabilitation in children with CP are to minimize the effect of physical impairments, to help the child gain independence in the community, and to improve the quality of life of the handicapped children and their families who have a major role to play in the process.[26] Rehabilitation in children with CP can differ depending on the clinical type and severity, associated disabilities, physiological age of the child, and socioeconomic factors. In addition, visual, auditory, cognitive disorders, seizures, learning disabilities, and emotional problems may influence intervention outcomes.[23,27]

Physiotherapy plays a central role in managing the children with CP and it focuses on function, active movement, and optimal use of the child's potential. Physiotherapy uses physical approaches to promote, maintain, and restore physical, psychological, and social well-being.[28,29] Interventions for children with CP must be efficient and cost-effective.[14,30] Rehabilitation team members try to provide strategies that will help children reach their full and independent potential in their homes and communities. The rehabilitation influence is not restricted to the medical center and treatment gymnasium, but frequently includes the child's functioning settings within the home, school, recreation, and community environments.[6,31]

The physiotherapist focuses on gross motor skills and functional mobility in the management of motor deficits in CP.[1] Positioning, sitting, walking with or without assistive devices and orthoses, wheelchair use and transfers are areas that the physiotherapist works on. The physiotherapist performs and plans physiotherapy and home program and provides the interphase with the school and recommends equipment and orthosis.[30,32] This approach also focuses on gross and fine motor activities, visual, and sensory processing skills needed for basic activities of daily living such as eating, dressing, toileting and bathing; it includes training in school-related skills and also strategies to help children compensate for specific deficits in their daily lives.[25,33]

Evaluation

In the assessment of a child with CP, questions such as "Why is physiotherapy required?", "What are the effective neurophysiological and biomechanical mechanisms?", " How do the accompanying problems affect the condition?" should be answered.

Motor assessment should include muscle tone, the capacity of co-contractions of muscles, involuntary extremity and trunk movements, stability of extremities, correction and equilibrium reactions, sitting balance, upper extremity and hand functions, sensorial-perceptional problems, speech and language function, and feeding. In addition, orthosis, mobilization devices and other adaptive equipment, general health status of the child, and social-cultural and economical status of the family should be evaluated.[13,19] Realistic goals should be defined, and plans for any changes in care should also be communicated with other members of the treatment team, family, and the patient.[23,26,34]

In the assessment of motor level, functional development, and daily living activities, Gross Motor Function Measure (GMFM),[35] Gross Motor Function Measure Classification System (GMFCS),[36] Pediatric Functional Independence Measure (WeeFIM),[37] and Pediatric Evaluation of Disability Inventory (PEDI)[38] may be directive.

More recently, GMFM which has been shown to be a valid, reliable, and sensitive tool, has been utilized for documentation of improvement in function.[39] It was initially an 88-item test, then designed to include 66 items, inquiring five areas of function including lying and rolling, sitting, crawling and kneeling, standing, and walking, running, and jumping. The GMFCS is a common classification system and an evidence-based classification tool of five levels ranging from level I, which includes children with minimal or no disability with respect to community mobility, to level V which includes children who are totally dependent on external assistance for mobility.[35] Range-of-motion should be assessed using standardized testing measures.[40] It is important to document tone with the Modified Ashworth Scale, which is a good clinical

method. Reduction in the score serves as one of the ways to document a beneficial tone modulation from a treatment.[41]

The most important parameter of the assessment is observation. The active and self-performed movements and the posture of the children during activity or play with the toys and their independence levels are watched.[42] Observation also includes alertness of the child, communication, habits during the movements, and behaviors of the parents.[43]

Clinical types of CP are most commonly classified according to neurological symptoms. Generally we can summarize the problems based on clinical types;

Spastic cerebral palsy. Spasticity is a major clinical feature of over 75% of cases with CP. The most important problems in children with spastic CP are spasticity in extremity muscles, hypotonus in trunk muscles, insufficiency in protective and equilibrium reactions, stereotype movement patterns, slow and firm movements, combined reactions, joint deformities due to muscle strength inequality, posture and gait disorders.[1,44]

Athetoid cerebral palsy. Main problems include fluctuations in muscle tone, involuntary extremity and trunk movements, insufficiency of stabilization of the trunk and extremities, insufficiency of muscle co-contraction, and insufficiency of correction, equilibrium and protective reactions.[45]

Ataxic cerebral palsy. It generally presents with hypotonus, weak co-contraction, postural stabilization insufficiency, dissymmetry, and coordination disorders of movement.[46] In children with *hypotonic cerebral palsy*, weak head control, weakness in trunk stabilization and control, insufficiency of correction, equilibrium and protective reactions, joint hypermobility are seen as the main problems.[47]

Applications

Physiotherapists emphasize the need for the practice to be evidence-based whenever possible.[19,30] Recent reviews have addressed the effectiveness of physiotherapy interventions for children with CP focusing on neurodevelopmental therapy (NDT),[34] training on muscle strengthening exercises,[35] conductive education,[36] various physiotherapy interventions,[48-51] and orthotic devices.[52] Recently, methods such as biofeedback and electrical stimulation have been accepted as adjunct therapies.[43,51]

The most common physiotherapy approach used in children with CP is the Bobath NDT approach.[32,48,51] Berta and Karel Bobath, a physical therapist and a neuropsychiatrist, respectively, were pioneers in the treatment of CP. As early as the 1940s, they began to develop an approach that grew out from Berta Bobath's clinical observations and was initially understood in the context of the reflex movements, hierarchical development, and maturation theories. The Bobath approach has spread widely and heavily influenced physiotherapy for children with CP. According to the Bobaths, the motor problems of CP arise generally from central nervous system dysfunction, which interferes with the development of normal postural control against gravity and impedes normal motor development. The goal was the establishment of normal motor development and function, the prevention of contractures and deformities. Their NDT approach focused on sensory motor components of muscle tone, reflexes and abnormal movement patterns, postural control, sensation, perception, and memory. Also, the main aim of NDT was to change the neural-based motor responses of the central nervous system. Advances in the Bobath approach continue and it is currently regarded as a "concept" rather than a technique. The concept encompasses three main principles including facilitation, stimulation, and communication in order to provide normal movement experience, minimize motor-sensory disorders, and improve functional independence levels of children with CP. Individual growth and cognitive characteristics of the child should also be considered among important principles. [22,32,48,53]

Exercises are planned structured activities involving repeated movements of skeletal muscles to improve or maintain levels of physical fitness. Several types of exercises are utilized to improve the child's motor ability.[54]

Passive stretching. It is a manual application for spastic muscles to relieve soft tissue tightness. Manual stretching may increase range of movements, reduce spasticity, or improve walking efficiency in children with spasticity.[54]

Static weight-bearing exercises. They are commonly used in order to stimulate antigravity muscle strength, prevent hip dislocation, improve bone mineral density, improve self-confidence, reduce spasticity, and improve fine motor function.[55]

Muscle strengthening exercises. It aims to increase the power of weak antagonist muscles and of the corresponding spastic agonists and to provide the functional benefits of strengthening in children with CP.[56]

Functional exercises. They combine aerobic and anaerobic capacity and strength training in ambulatory children, and significantly improve physical fitness, the intensity of activities, and quality of life. Training programs on static bicycles or treadmill are beneficial for gait and gross motor development without enhancing spasticity and abnormal movement patterns.[57]

Electrical stimulation. It is proposed as a useful modality in CP due to the lack of selective muscle control required for specific strengthening programs. In particular, neuromuscular and threshold electrical stimulation is used for strengthening the quadriceps muscles in ambulatory diplegic children with CP, who find resistive strength training difficult.[58]

Spasticity in children with CP may be a useful substitute for deficiency of motor strength, in that it facilitates standing with extensor hypertonia and may provide power to voluntary contractions. However, it often exerts negative influence and leads to aggravation of motor disability, impairs standing and walking due to clonus, scissoring, flexor or extensor spasticity, slows voluntary movements, affects proper positioning, and increases the risk for contractures and joint subluxation. Pain due to extreme spasticity and difficulty in providing hygiene are additional problems.[59] Spasticity reduction is considered for the following aims: to improve positioning and active function, prevent musculoskeletal complications, and reduce the need for corrective surgery in the future.[60] Oral medications,[61] botulinum toxin,[62] selective posterior rhizotomy,[63] intratechal baclofen,[64] and orthopedic surgery[65] are used to reduce spasticity.[66] The purpose of physiotherapy program before using botulinum toxin is to prepare the child to the new posture and normal movement experiences. When botulinum toxin is chosen for achieving functional goals like sitting, standing, and improving the gait pattern, multiple muscle groups need to be treated usually in multilevel applications. The purposes of the physiotherapy after utilization are to protect musculoskeletal system biomechanics and range of motion, improve muscle strength and endurance, provide agonist and antagonist muscle balance, and give proprioceptive training. Orthosis application is important to obtain longer efficacy of botulinum toxin and to protect muscle length. Recent studies indicated that botulinum toxin plus intensive physiotherapy applications increased the success in the field.[67]

In addition to physiotherapy and medical treatment, children with spastic CP are often treated surgically. Depending on the individual child, muscle or tendon lengthening, tendon transfer, and bone correction aim to restore the functional range of motion, diminish muscle strength imbalance, and align the limbs to a functionally correct position.[68] The aims of these interventions are to minimize the development of contractures and deformities by normalizing the muscle tone, facilitating adequate stretch to muscles, and increasing the active range of motion, to strengthen weak muscles, to improve mobility and acquire functional motor skills, and to promote functional independence in the house, at school, and in the community.[69] Physiotherapy applications after surgery may differ depending on the child's general health, site of surgery, and surgical approach. The purposes of the applications are to increase range of motion, provide muscle strength balance, protect gains by positioning, develop new movement abilities, maintain biomechanical regularity, and provide re-ambulation. Proprioceptive training has great importance in the applications. Immobilization period after surgery depends on the time of mobilization with partial or full weight and surgical approach and protocol. If the immobilization period is long after surgery, by opening windows on casting or after taking off the plaster, electrical stimulation may be useful for strengthening weak muscles.[70-72] Specialized physiotherapy programs have indicated that functional improvements can only be maintained with regular practice and the effects of intensive strength training start to disappear after a 3-month detraining period.[73] Postoperative physiotherapy applications consist of passive, assisted, and active movement of the limbs and strengthening exercises have also been recommended for patients with CP to improve muscle strength and some functional parameters.[13,24,32,56,72]A variety of handling techniques can also be used based on the NDT approach. The Bobath approach comprises appropriate means in particular for proprioceptive training, normal movement experience, and integration of the gained normal movements in the daily living activities.

In all rehabilitation applications for the children with CP, parents should always follow the treatment and should be encouraged to participate in the treat-

ment when required.[74] The parents should be patient and taught to give enough time to their children for the movement and not to pacify the children. Normal movement is the base of the normal function, and functions are required for the daily living activities.[72,75] The parents should be made aware that the child could achieve normal movements faster if they offer them appropriate occasions for functional activities in daily living. Even if the motor movements are retarded, the activities should be parallel with the cognitive level of the child and this condition should be explained to the families.[76] In rehabilitation applications, information about the daily lives of the children and their family should be derived for different environments such as home, school, and play should be learned and family relations, life styles and social-economical and cultural factors should be taken into consideration.[42,43,48]

Conclusion

In physiotherapy applications for the children with CP, talking on only "treatment" terminology is insufficient. Instead, it is more accurate to use "management" since physiotherapy of children with CP not only includes the treatment of the motor problems, but also considers all requirements of the child and a good family-child relation. During the applications, the problems of the child should be thought in the context of a wide spectrum having motor, cognitive, sensorial, emotional, and social aspects.

It is very important to determine realistic goals. The rehabilitation team should determine the short- and long-term targets consistent with the condition of the child and should control at certain intervals whether these targets have been achieved. If an unrealistic target is noted, a correct connection should be established between the actual condition of the child and the new target. During the rehabilitation applications, planning all day activities, working with the family, integration to daily living activities, helping the child, increasing the quality of life are important. Determination of the main targets during the treatment, taking the child's personal characteristics into consideration, providing occasions for the child to use his/her functional abilities in the play are also important.

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