

Hereditör Spastik Paraparezi Tanılı 4 Yaşındaki Bir Olguda Klinik Değerlendirme ve Fizyoterapi Yaklaşımları: Bir Olgu Sunumu

Clinical Assessment and Physiotherapy Approaches in a 4-Year-Old Case with Hereditary Spastic Paraparesis: A Case Report

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ÖZET

Bu çalışmanın amacı, sıklıkla serebral palsi ile karıştırılan hereditör spastik paraparezinin fizik tedavi ve rehabilitasyon yöntemlerine göre değerlendirilmesidir. Bu amaçla hereditör spastik paraparezi tanılı 4 yaşındaki olgu fizyoterapi ve rehabilitasyon yöntemleriyle değerlendirildi. Değerlendirmeler sırasında olgunun öyküsü için ailesiyle görüşüldü. Daha sonra sırasıyla postür analizi, kas kısalık değerlendirmeleri, normal eklem hareketleri, kas kuvvet değerlendirmeleri, kas tonusunun değerlendirilmesi, duyu değerlendirmesi, kontraktürlerin var olup olmadığı, ambülasyon düzeyi, el becerilerinin değerlendirilmesi, ağrı düzeyi, denge değerlendirmesi, günlük yaşam aktiviteleri ile beraber yürüme analizi yapıldı. Tüm bu değerlendirmeler sonucunda hereditör spastik parapareziye (HSP) bağlı, kortikospinal yol ve medulla spinalisin arka kordunun retrograd akson dejenerasyonu ile ilerleme gösteren spastisite durumu, kas kuvvetinde azalma, yürüme ve denge bozukluğu, tendon reflekslerinin artışının olgumuzda olduğu belirlendi. Hereditör spastik paraparezi genetik heterojen özellik göstermesinden dolayı ve olgunun analiz edilmesini zorlaştırdığı için özellikle de spastik tip serebral palsi ile karıştırılmaması için ayırıcı tanının yapılması ciddi önem taşımaktadır. Serebral palsi, gelişme durumunda olan bir beynin doğum öncesi, doğum sırasında ve doğum sonrasında oluşan sebeplerle meydana gelen hasarın bireyin postürünün, kas-iskelet sisteminin, denge ve yürümenin, bilişsel fonksiyonların etkilenmesidir. Serebral palsi'de beyindeki hasar ilerlemez, fakat hastada ortaya çıkan klinik bulgu ve belirtiler ilerleyicidir. Hereditör spastik paraparezi'nin başlangıç durumu erken çocukluk ile birlikte erişkin çağ olabilirken, serebral palsi'de erken çocukluk çağında olmaktadır.

Anahtar Kelimeler: Hereditör spastik paraparezi, serebral palsi, fizyoterapi

ABSTRACT

The aim of this study is to evaluate hereditary spastic paraparesis, which is frequently confused with cerebral palsy, according to physical therapy and rehabilitation methods. For this purpose, a 4-year-old case diagnosed with hereditary spastic paraparesis was evaluated using physiotherapy and rehabilitation methods. During the assessments, the family was interviewed to obtain the case history. Subsequently, the following evaluations were conducted in order: posture analysis, muscle tightness assessments, range of motion measurements, muscle strength assessments, muscle tone evaluation, sensory examination, assessment for contractures, ambulation level, evaluation of hand skills, pain level, balance assessment, activities of daily living, and gait analysis. As a result of these evaluations, it was determined that the case exhibited spasticity due to hereditary spastic paraparesis (HSP), characterized by retrograde axonal degeneration of the corticospinal tract and posterior cord of the spinal cord, along with decreased muscle strength, gait and balance disorders, and increased tendon reflexes. Due to the genetic heterogeneity of hereditary spastic paraparesis and the challenges it poses in case analysis, conducting a differential diagnosis is critically important, particularly to avoid confusion with spastic cerebral palsy. Cerebral palsy refers to damage occurring in the developing brain due to prenatal, perinatal, or postnatal causes, affecting an individual's posture, musculoskeletal system, balance and gait, and cognitive functions. In cerebral palsy, the brain damage does not progress, but the clinical signs and symptoms in the patient are progressive. While the onset of hereditary spastic paraparesis can occur in early childhood or adulthood, cerebral palsy manifests in early childhood.

Keywords: Hereditary spastic paraparesis, cerebral palsy, physiotherapy

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INTRODUCTION

HSP (Hereditary spastic paraparesis) is a heterogeneous neurodegenerative disease characterised by genetic disorders that cause progressive muscle weakness and spasticity in the lower limbs, along with distal axonal degeneration in the corticospinal tracts. It can be congenital or appear at any stage of life (1-4). HSP is classified according to its mode of inheritance, chromosomal locus, and causative mutation (1). Clinically, it is divided into two types: pure and complex (5). In complex HSP, the degenerative process affects many parts of the nervous system, leading to numerous neurological problems such as seizures, extrapyramidal involvement, ataxia, optic atrophy, muscle atrophy and neuropathy, and cognitive impairment (6-7). HSP can exhibit autosomal dominant, autosomal recessive, X-linked recessive, or mitochondrial inheritance patterns (1). Although the overall prevalence of HSP is reported to be 1.8/10,000, the disease manifests clinically with very different symptoms depending on the age of onset (2-3). There is no specific treatment method that can prevent, halt the progression of, or reverse the progressive disorders associated with HSP. Today, the management of hereditary spastic paraplegia (HSP) is largely based on symptomatic and multidisciplinary approaches (8). Due to the progressive neurodegenerative nature of the disease, the primary objectives of current therapeutic strategies are to reduce spasticity, preserve walking capacity, support muscle strength and balance performance, prevent contractures, manage secondary symptoms such as pain and fatigue, and maintain the individual's functional independence at the highest possible level (4). Pharmacological options include oral antispastic agents (e.g., baclofen), botulinum toxin applications in selected cases, and intrathecal baclofen therapy in the presence of advanced spasticity (9). However, the current literature emphasizes that pharmacological treatments are mostly supportive and do not alter the natural course of the disease when used in isolation (8).

Rehabilitation interventions are a fundamental component of HSP management (10). Physiotherapy programs may encompass stretching exercises, strengthening exercises, balance and posture training, gait training, functional task-oriented activities, aerobic conditioning, and the use of assistive devices when necessary (5). In recent years, it has been reported that robot-assisted gait training, treadmill-based adaptive walking programs, hydrotherapy, neuromuscular electrical stimulation, and balance-oriented rehabilitation approaches offer promising results (6). Nonetheless, these findings must be interpreted with caution due to the heterogeneity of patient groups, genotype-phenotype diversity, and limited sample sizes (10).

Research in the field of physiotherapy for HSP has primarily focused on the analysis of gait

patterns, functional outcome measures, balance performance, fall risk, and the determination of disease severity (7). Instrumented gait analysis and objective performance tests are gaining increasing importance in the planning of individualized rehabilitation programs (8).

Although various studies in the literature examine physiotherapy and rehabilitation applications in HSP, high-level evidence regarding standardized assessment protocols and the optimal frequency, intensity, duration, and content of exercise programs remains limited (5). Therefore, in clinical practice, treatment programs are frequently personalized according to the patient's age, functional level, symptom profile, concomitant complications, and individual goals (4).

In this context, following a comprehensive clinical evaluation, an age-appropriate, function-oriented, and individualized physiotherapy program was designed for a 4-year-old pediatric case diagnosed with HSP. The primary goals of the program were established as supporting lower extremity functions, enhancing mobility, increasing participation in activities of daily living, and preventing progressive secondary musculoskeletal complications.

CASE PRESENTATION

The demographic characteristics of the four-year-old girl were evaluated; her height was measured at 100 cm and her body weight at 16 kg. It was determined that the patient was the only child in the family and that her 32-year-old mother was employed as a flight attendant.

Review of the obstetric history revealed that the mother experienced an uncomplicated pregnancy and, in February 2021, delivered a healthy infant at 40 weeks of gestation via spontaneous vaginal delivery. The newborn weighed 3100 g and measured 50 cm in length. No complications were reported during labor or in the early postnatal period.

Assessment of developmental milestones indicated that the child achieved basic motor skills such as rolling, sitting, and crawling within the expected age range. However, concerns regarding the progression of gait development emerged during clinical follow-up. According to the literature, independent walking is typically acquired between 9 and 18 months of age, and cases outside this developmental window warrant further evaluation (15). Although the absence of independent walking at 12 months is not considered pathological in isolation, the persistence of delayed gait acquisition in the subsequent period prompted the family to seek medical consultation. Comprehensive assessments, including pediatric neurology, metabolic disease screening, and genetic investigations, resulted in a diagnosis of Hereditary Spastic Paraplegia.

A detailed review of the motor development process showed that the patient began walking

with support at 18 months and achieved independent ambulation at 22 months. Following the diagnosis, the family pursued different therapeutic options, and electrotherapy interventions were implemented from 18 months of age for approximately 7–8 months.

Due to delayed access to appropriate rehabilitation services, the patient was referred to our institution only at the age of 3 years and was enrolled in a comprehensive physiotherapy program for the first time. This process highlights the importance of early assessment, family counseling, and timely initiation of structured rehabilitation programs in pediatric neurological cases.

Physiotherapy and Rehabilitation Assessment Findings

Postural Analysis

Anteroposterior View: The head position is centred on the midline, with noticeable depression (lowering) of the left shoulder. Increased lateral flexion and swaying of the trunk were observed during walking. An asymmetrical swaying pattern is present in upper extremity movements. Pelvic stability is maintained, and the patella is positioned in the midline on both sides. When assessing the foot progression angle, bilateral internal rotation is noted, more pronounced on the right side compared to the left. Figure 1 shows the anteroposterior view of the case.



Figure 1. Anteroposterior view of the specimen

Lateral View: The head position is shifted anteriorly (forward head posture), and a slight extension posture is observed in the torso. There is a marked increase in lumbar lordosis. While the hip joint is in a flexion posture, hyperextension (recurvatum) in the knee joint and a slight plantar flexion tendency in the ankle joint is noticeable. The lateral view of the case is shown in Figure 2.



Figure 2. Lateral view of the case

Postural assessment findings reflect characteristic patterns specific to hereditary spastic paraparesis. Increased lumbar lordosis and hip flexion may be associated with spastic hamstrings and weak abdominal muscle activity. Knee hyperextension can be explained by the spastic pattern of the quadriceps muscle and hypertonicity in the plantar flexors. Asymmetric shoulder position and increased trunk sway suggest upper extremity compensations. These postural abnormalities negatively affect balance and gait mechanics, indicating that rehabilitation programmes should focus particularly on core stabilisation, postural correction techniques, and proprioception training. Internal rotation in the foot progression angle may be related to spasticity in the hip internal rotators or tibial torsion anomalies and should be considered in orthotic selection.

Anthropometric Measurements

The patient's height and weight measurements are within the normal percentile values for a 4-year-old child. No difference in length was detected between the two legs in the lower extremity length measurements (SIAS-malleolus distance bilateral 49 cm). The bilateral symmetry of the umbilicus-malleol measurements (56 cm) and their consistency with the SIAS-malleol measurements indicate that pelvic symmetry is preserved. These findings support the absence of any lower extremity length discrepancy or pelvic obliquity in this case. The measurement results indicate that the asymmetric involvement frequently seen in hereditary spastic paraparesis is not present in this case. However, the internal rotation observed in the gait analysis is thought to be related to muscle tone imbalance rather than skeletal structural abnormalities. In light of these findings, the rehabilitation programme planned to focus particularly on correcting lower limb muscle imbalances and proprioception training. The anthropometric data of the case are shown in Table 1.

Table 1. Anthropometric data of the case

Height	100 cm
Weight	16 kg
Age	4 years
Asis-malleolus right leg	49 cm
Asis-malleol left leg	49 cm
umbilicus-right malleolus	56 cm
umbilicus-left malleolus	56 cm

Asis: Anterior superior iliac spine; cm: centimetre; kg: kilogram

Functional Assessment of Activities of Daily Living

When the patient's activities of daily living were assessed, it was observed that she could perform independent double-leg hops, but he performed this movement with a toe-off pattern and was unable to do so while wearing an ankle-foot orthosis (AFO). Although the patient has the ability to run, this is again accompanied by a pronounced toe-walking pattern. The patient can perform the squatting-standing movement independently without difficulty. Although walking function is independent, characteristic gait abnormalities such as slight toe-walking, knee hyperextension, and internal rotation are noticeable. There are no limitations in sitting position and position change activities. The ability to stand on one foot with upper extremity support is present. The patient can independently perform stair climbing and descending activities. The right upper extremity is used dominantly.

These findings reflect the functional characteristics typically seen in hereditary spastic paraparesis. The toe-walking pattern and knee recurvatum suggest spasticity in the gastrocnemius-soleus complex and weakness in the quadriceps muscle. The inability to perform double-leg hops while wearing an AFO may be explained by the orthosis's movement restriction or effects on proprioception. The ability to climb stairs independently and change position indicates that proximal lower limb muscle strength is preserved. The ability to stand on one foot with upper limb support, however, indicates the presence of balance disorders. These findings emphasise the importance of gait mechanics, balance training, and orthotic adaptation in treatment planning.

Assessment of Motor Function and Manual Dexterity

The patient's motor function and manual dexterity were assessed using international standard classification systems. Our patient, classified as Level 2 on the Gross Motor Function Classification System (GMFCS), is able to walk independently but experiences some

limitations when moving outdoors and within the community. She may require support or a handrail when climbing stairs and may experience difficulties when walking long distances or on uneven surfaces. The patient is classified as Level 1 on the Manual Ability Classification System (MACS) and can manipulate objects with ease and perform hand functions independently. Although minimal difficulties are observed in fine motor skills, this does not affect daily activities; only slight difficulties are observed in writing and using small objects. When clinically evaluated, GMFCS Level 2 findings indicate the presence of moderate lower limb involvement due to hereditary spastic paraparesis in our patient. MACS Level 1 indicates that the upper extremities are preserved. These findings are fully consistent with the typical presentation of the disease and support the predominance of lower extremity involvement. In rehabilitation planning, approaches that increase walking endurance, improve balance, and reduce energy consumption have been prioritised in accordance with GMFCS Level 2 criteria. The preservation of upper limb function (MACS Level 1) provides the patient with a significant advantage in the use of assistive devices and transfer activities. This is considered an important factor in supporting the patient's functional independence during the rehabilitation process.

Joint Range of Motion and Clinical Assessment Findings

In the assessment of ankle joint range of motion, active dorsiflexion was measured as 20° and passive dorsiflexion as 45° bilaterally with the knee positioned in 90° flexion. These findings indicate marked shortening of the gastrocnemius-soleus complex.

In the lower extremity assessments, the femoral anteversion angle was measured as 70° on the right side and 60° on the left side. Popliteal angle measurements were determined as 190° on the right leg and 185° on the left leg, indicating the presence of significant recurvatum in the knee joint. The Thomas test was positive on both sides, suggesting shortening of the hip flexors. The tibiofemoral angle was measured at 8° on the right and 9° on the left. The Duncan-Ely and silfverskiold tests were negative on both sides. Joint range of motion assessments revealed marked gastrocnemius-soleus shortening in the patient. The increase in dorsiflexion angle with knee extension is an expected finding due to the two-joint nature of the gastrocnemius muscle. The asymmetry and high values in the femoral anteversion angles suggest a possible rotational problem in the hip joint. The increase in popliteal angles is consistent with hyperextension of the knee joint. A positive Thomas test confirms shortening of the hip flexors, while negative Duncan-Ely and Silver skiold tests indicate that hamstring and gastrocnemius shortening are not isolated. In light of these findings, the rehabilitation programme will focus particularly on

gastrocnemius-soleus stretching exercises, increasing hip flexor flexibility, and improving knee control. The patient's muscle tone assessment results are shown in Table 2.

Table 2. Patient's muscle tone assessment results

Hip	R	L
Flexor		
Extensor	0	0
Adductor Hip 0-Knee 0	0	0
Adductor Hip 0-Knee 90	0	0
Abductor	2	2
Internal Rotation	1+	1+
External Rotation	0	0
Knee		
Hamstring	1+	1+
Ankle		
Plantar Flexor	2	2
Clonus	+	+

R: Right; L: Left

The spasticity assessment indicates that spasticity is most prominent in the plantar flexors (Grade 2) and hip abductors (Grade 2). Mild spasticity (Grade 1+) was detected in the hamstrings and hip internal rotators. Bilateral clonus supports upper motor neuron involvement. This spasticity pattern is consistent with the lower extremity-dominant involvement typically seen in hereditary spastic paraparesis. The marked spasticity in the plantar flexors, in particular, explains the patient's toe-walking pattern. Abductor spasticity may be related to the abnormalities in pelvic movement observed during gait. In light of these findings, spasticity management has been identified as one of the primary goals of the rehabilitation programme. Appropriate stretching exercises, positioning techniques, and pharmacological approaches, if necessary, have been included in the treatment plan. Given that the presence of clonus may adversely affect the patient's balance and coordination, specific interventions targeting these areas have been planned.

Muscle strength assessment indicates weakness most prominently in the ankle dorsiflexors (3/5) and plantar flexors (4/5). Mild strength loss (4/5) was detected in the hip abductors and hamstrings. These findings are consistent with the distal dominant involvement pattern typically seen in hereditary spastic paraparesis. The dorsiflexor weakness explains the patient's difficulty in controlling the ankle and the toe-walking pattern observed during gait. The mild weakness in the plantar flexors indicates that muscle performance is affected despite the presence of spasticity. The mild weakness in the hip abductors may affect pelvic stability during walking. The loss of strength in the hamstrings may have a negative effect on knee control. Based on

these assessments, the rehabilitation programme prioritised exercises to strengthen the ankle dorsiflexors and plantar flexors, as well as the hip abductors and hamstrings. Considering both the loss of strength and the presence of spasticity, the exercises were planned in appropriate positions and doses. The patient's muscle strength test results are shown in Table 3.

Table 3. Results of Muscle Strength Assessment for the Case

Hip	R	L
Extensor	5	5
Flexor	5	5
Abd	4	4
Add	5	5
Int. Rot.	5	5
Ext. Rot.	5	5
Knee		
Ext.	5	5
Flex.	4	4
Ankle		
Dorsiflex.	3	3
Plantarflex.	4	4
Inversion	5	5
Eversion	4	4

R: Right; L: Left

Balance Assessment and Clinical Findings

The patient's balance performance was assessed in detail, yielding the following results: Static Balance: Our patient does not experience any problems in static balance tests (such as standing on one foot, tandem stance). She can maintain a stable stance with eyes open and closed. Postural sway is within normal limits.

Dynamic Balance: Partial difficulties were observed in dynamic balance activities (such as changing direction while walking, avoiding obstacles). The patient may experience balance loss when suddenly stopping or changing direction while walking. The patient has difficulty maintaining balance when walking on uneven surfaces.

The balance assessment reveals that the patient performs well in static balance but struggles in situations requiring dynamic balance. These findings are consistent with the balance disorders frequently seen in hereditary spastic paraparesis. Difficulties in dynamic balance may be related to a slight decrease in lower limb muscle strength, spasticity, and proprioception disorders. These difficulties, particularly during walking, are of a level that could affect the patient's mobility and safety within the community. The rehabilitation programme includes specific exercises aimed at improving dynamic balance (such as treadmill training, balance board exercises, and weight-shifting exercises). Proprioception training and safe walking strategies

will be emphasised. The patient's success in static balance provides a positive starting point for focusing rehabilitation on dynamic balance.

DISCUSSION

This study evaluated the effects of a 12-week individualised physiotherapy programme implemented in a 4-year-old child diagnosed with hereditary spastic paraparesis (HSP). HSP is a rare disease originating in the central nervous system, characterised by progressive spastic paraparesis, and its treatment requires a multidisciplinary approach. In this case, early initiation of physiotherapy intervention resulted in a reduction in spasticity, improvement in postural control and balance skills, improvement in gait pattern, and increased functional independence (9).

Managing spasticity is a primary goal in HSP cases. The stretching exercises applied in this case reduced tone in spastic muscles, leading to a significant decrease in Modified Ashworth Scale (MAS) scores. The literature also emphasises that passive stretching, active assisted stretching, and positioning techniques are effective in managing spasticity (11-12).

Improvements in motor functions and balance skills have enabled the child to move more independently in daily living activities. In particular, the increase in the Paediatric Balance Scale score indicates a significant improvement in dynamic balance capacity. This supports the effectiveness of increasing proprioceptive input and functional task-oriented exercises (13).

The improvement in gait pattern is related to increased muscle strength and improved postural stability. Strengthening the pelvic and hip muscles, in particular, has positively affected step symmetry and balance. These findings are consistent with similar studies (14).

Furthermore, the home exercise programme and education provided to the family contributed significantly to the treatment process by keeping the child active within their daily routine. This situation once again highlights the importance of family-centred approaches in paediatric rehabilitation.

CONCLUSION

This case study demonstrates that structured and multifaceted physiotherapy interventions initiated at an early age can have positive effects on neuromotor development, balance, gait, and functional independence in individuals diagnosed with HSP. However, long-term follow-up and advanced studies with larger samples will increase the generalisability of these findings.

Yazar katkıları: Fikir/Kavram: YA, BB Tasarım: YA, BÇ, GBD, BB Denetleme/Danışmanlık: YA, BÇ, GBD, BB Analiz ve/veya Yorum: YA, BÇ, GBD, BB Kaynak Taraması: YA, BÇ, GBD, BB Makalenin Yazımı: YA, BÇ, GBD, BB Eleştirel İnceleme: YA, BÇ, GBD, BB

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