Bölüm 4

SEREBRAL PALSİLİ BİREYLERDE ROBOTİK REHABİLİTASYON UYGULAMALARI

Gülseren DEMİR KARAKILIÇ[1]

GİRİŞ

Serebral Palsi (SP),henüz gelişimini tamamlamamış beyinde farklı lezyonlar nedeniyle oluşan, aktivite kısıtlanmasına, hareket ve postür bozukluğuna neden olan, progresif olmayan kalıcı bir bozukluktur (1). SP, çocukluk çağında yeti yitimine neden olan hastalıklar arasında ilk sırada yer almaktadır. SP prevalansı dünya çapında 1,5-2,5 /1000 arasında iken Türkiye'de benzer şekilde 1,5 /1000 olarak bulunmuştur (2, 3).SP'nin prevalansını arttırıcı sebepler; gebelik döneminde geçirilen hastalıkların fazla olması, doğum sırasında karşılaşılan zorluklar, akraba evliliklerinin fazla olması, doğum, bebeklik ve erken çocukluk dönemlerinde enfeksiyonların sık görülmesi ve yetersiz beslenme olarak sıralanabilir (4, 5).

SP'de çoğunlukla etiyolojik neden bulunamasa da sıklığa göre sıralarsak SP'nin prenatal, natal ve postnatal nedenlerden kaynaklandığı bilinmektedir (6). Prenatal dönemde erken doğum ve düşük doğum ağırlığı en sık nedenken; perinatal dönemde asfiksi en sık nedendir (7).

1. SINIFLANDIRMA

SP'de motor bozukluğun tipi, etkilenen taraf, bağımsızlık düzeyi gibi faktörlere bağlı olarak farklı sınıflama sistemleri kullanılmaktadır. En sık kullanılan sınıflandırma, Avrupa Serebral Palsi Sürveyans Grubu (Surveillance of Cerebral Palsy in Europe (SCPE) tarafından belirlenen klinik tipine göre sınıflandırmadır ve bu sınıflamaya göre SP; spastik (bilateral (diparetik ve kuadriparetik), unilateral (hemiparetik)),diskinetik (Kore-atetoid veya distonik), ataksik ve mikst olarak sınıflandırılmaktadır (8, 9). SCPE tarafından yapılan bir prevalans çalışmasında SP olgularının % 85,7'sinin spastik, % 6,5'inin diskinetik, % 4,3'ünün ataksik ve % 3,7'sinin mikst tip olduğu belirtilmiştir (10).

[1] Uzm. Dr., Yozgat Şehir Hastanesi Fiziksel Tıp ve Rehabilitasyon Kliniği, gulserendmr58@hotmail.com, ORCID iD: 0000-0003-1292-0835

6.3. Sanal gerçeklik tedavisi

Sanal gerçeklik tedavisi aktif hareketin sık sık tekrarlanması, hareketlerin oyun şeklinde yapılarak daha keyifli hale getirilmesi, nöroplastisiteyi arttırması nedeniyle son zamanlarda SP'li bireylerde sıklıkla kullanılmaktadır. SP'li çocuklarda sanal gerçeklik tedavisinin konvansiyonel fizik tedavi ile birlikte uygulanması önerilir (44, 64). Acar ve ark. tarafından 2016 yılında bir çalışmada 30 hemiparetik SP'li çocuk hasta ve kontrol grubuna ayrılmış, hasta grubuna klasik yoğun fizyoterapiye ek olarak altı hafta boyunca haftada iki seans sanal gerçeklik tedavisi uygulanmış; hasta grubunda üst ekstremite fonksiyonlarda iyileşmenin daha fazla olduğu bulunmuştur (65). 2019 yılında yapılan randomize kontrollü çalışmaların metaanalizinde sanal gerçeklik tedavisinin SP'li bireylerde denge üzerine olumlu etkileri olduğunu ve iyi bir tedavi seçeneği olduğunu vurgulamışlardır (66). 2020 yılında yapılan sistematik bir derlemede SP'li çocuklarda sanal gerçeklik tedavisinin denge ve yürüme üzerine olumlu etkilerinin olduğu ancak vaka sayılarının az olması ve randomize kontrollü çalışmaların yetersiz olduğu vurgulanmıştır (67). 2023 yılında yapılan sistematik bir derlemede SP'li çocuklarda sanal gerçeklik tedavisinin el fonksiyonlarını olumlu etkilerinin olduğu ancak vaka sayılarının az olması ve randomize kontrollü çalışmaların yetersiz olduğu vurgulanmıştır.

SONUÇ

SP'li çocukların rehabilitasyon süreçleri çok uzun süre devam eder ve konvansiyonel tedavi uygulanan hastalar bir süre sonra sıkılmakta, seanslarda yeterli katılım da bulunmamaktadır. Konvansiyonel fizyoterapinin robotik rehabilitasyonla desteklenmesi, motivasyonu ve devamlılığı arttırdığı için hedeflenen fonksiyona ulaşımı kolaylaştırır.

KAYNAKÇA

1. Vitrikas K, Dalton H, Breish D. Cerebral palsy: an overview. American family physician. 2020;101(4):213-20.
2. McIntyre S, Goldsmith S, Webb A, Ehlinger V, Hollung SJ, McConnell K, et al. Global prevalence of cerebral palsy: A systematic analysis. Developmental Medicine & Child Neurology. 2022;64(12):1494-506.
3. Subaşi İÖ, Bingöl İ, Yaşar NE, Dumlupinar E, Ata N, Ülgü MM, et al. Prevalence, Incidence, and Surgical Treatment Trends of Cerebral Palsy across Türkiye: A Nationwide Cohort Study. Children. 2023;10(7):1182.
4. Serdaroğlu A, Cansu A, Özkan S, Tezcan S. Prevalence of cerebral palsy in Turkish children between the ages of 2 and 16 years. Developmental medicine and child neurology. 2006;48(6):413-6.

5. Tüzün H, Eker L. Serebral paralizi ve koruyucu hekimlik. Sürekli Tıp Eğitimi Dergisi. 2001;10(8):294-7.
6. Vova J. Cerebral Palsy: An Overview of Etiology, Types and Comorbidities. OBM Neurobiology. 2022;6(2):1-25.
7. Abd Elmagid DS, Magdy H. Evaluation of risk factors for cerebral palsy. The Egyptian Journal of Neurology, Psychiatry and Neurosurgery. 2021;57:1-9.
8. Cans C, Dolk H, Platt MJ, Colver A. Recommendations from the SCPE collaborative group for defining and classifying cerebral palsy. Developmental medicine and child neurology. 2007;49:35.
9. Morris C. Definition and classification of cerebral palsy: a historical perspective. Developmental Medicine & Child Neurology. 2007;49:3-7.
10. Johnson A. Prevalence and characteristics of children with cerebral palsy in Europe. Developmental medicine and child neurology. 2002;44(9):633-40.
11. Singer HS, Mink JW, Gilbert DL, Jankovic J. Movement disorders in childhood: Academic press; 2015.
12. Morris C, Bartlett D. Gross motor function classification system: impact and utility. Developmental medicine and child neurology. 2004;46(1):60-5.
13. Gunel M, Mutlu A. Disability and its relation with functional independence in children with cerebral palsy: an ICF study of preliminary clinical experience from Turkey. Fizyoterapi Rehabilitasyon. 2007;18(3):171.
14. Akpinar P, Tezel CG, Eliasson A-C, Icagasioglu A. Reliability and cross-cultural validation of the Turkish version of Manual Ability Classification System (MACS) for children with cerebral palsy. Disability and rehabilitation. 2010;32(23):1910-6.
15. El Ö, Baydar M, Berk H, Peker Ö, Koşay C, Demiral Y. Interobserver reliability of the Turkish version of the expanded and revised gross motor function classification system. Disability and rehabilitation. 2012;34(12):1030-3.
16. Patel DR, Neelakantan M, Pandher K, Merrick J. Cerebral palsy in children: a clinical overview. Translational pediatrics. 2020;9(Suppl 1):S125.
17. Jones MW, Morgan E, Shelton JE, Thorogood C. Cerebral palsy: introduction and diagnosis (part I). Journal of Pediatric Health Care. 2007;21(3):146-52.
18. Sadowska M, Sarecka-Hujar B, Kopyta I. Cerebral palsy: current opinions on definition, epidemiology, risk factors, classification and treatment options. Neuropsychiatric disease and treatment. 2020:1505-18.
19. Benini R, Dagenais L, Shevell MI, Consortium RdlPCaQ. Normal imaging in patients with cerebral palsy: what does it tell us? The Journal of pediatrics. 2013;162(2):369-74.e1.
20. Franki I, Mailleux L, Emsell L, Peedima M-L, Fehrenbach A, Feys H, et al. The relationship between neuroimaging and motor outcome in children with cerebral palsy: A systematic review–Part A. Structural imaging. Research in developmental disabilities. 2020;100:103606.
21. Zimmerli L, Krewer C, Gassert R, Müller F, Riener R, Lünenburger L. Validation of a mechanism to balance exercise difficulty in robot-assisted upper-extremity rehabilitation after stroke. Journal of neuroengineering and rehabilitation. 2012;9(1):1-13.
22. Beretta E, Storm FA, Strazzer S, Frascarelli F, Petrarca M, Colazza A, et al. Effect of robot-assisted gait training in a large population of children with motor impairment due to cerebral palsy or acquired brain injury. Archives of physical medicine and rehabilitation. 2020;101(1):106-12.

23. Wallard L, Dietrich G, Kerlirzin Y, Bredin J. Effect of robotic-assisted gait rehabilitation on dynamic equilibrium control in the gait of children with cerebral palsy. Gait & posture. 2018;60:55-60.
24. Yazıcı M, Livanelioğlu A, Gücüyener K, Tekin L, Sümer E, Yakut Y. Effects of robotic rehabilitation on walking and balance in pediatric patients with hemiparetic cerebral palsy. Gait & Posture. 2019;70:397-402.
25. Mattern-Baxter K, Bellamy S, Mansoor JK. Effects of intensive locomotor treadmill training on young children with cerebral palsy. Pediatric physical therapy. 2009;21(4):308-18.
26. Klobucka S, Ziakova E, Klobucky R. P178–2253: The effect of age on the improvement in motor function in patients with cerebral palsy after undergoing robotic-assisted locomotor therapy. European Journal of Paediatric Neurology. 2015;19:S143-S4.
27. Romei M, Montinaro A, Piccinini L, Maghini C, Germiniasi C, Bo I, et al., editors. Efficacy of robotic-assisted gait training compared with intensive task-oriented physiotherapy for children with Cerebral Palsy. 2012 4th IEEE RAS & EMBS International Conference on Biomedical Robotics and Biomechatronics (BioRob); 2012: IEEE.
28. Pawłowski M, Gąsior J, Mrozek P, Bonikowski M, Błaszczyk J, Dąbrowski M. Ocena treningu z wykorzystaniem zautomatyzowanej ortezy Lokomat (Hocoma) w usprawnianiu dzieci i młodzieży z mózgowym porażeniem dziecięcym–doniesienie wstępne. Neurologia. 2014;47:35-40.
29. Wu Y-N, Hwang M, Ren Y, Gaebler-Spira D, Zhang L-Q. Combined passive stretching and active movement rehabilitation of lower-limb impairments in children with cerebral palsy using a portable robot. Neurorehabilitation and neural repair. 2011;25(4):378-85.
30. Schmartz AC, Meyer-Heim AD, Müller R, Bolliger M. Measurement of muscle stiffness using robotic assisted gait orthosis in children with cerebral palsy: a proof of concept. Disability and Rehabilitation: Assistive Technology. 2011;6(1):29-37.
31. Filiz MB, Toraman NF, Çiftçi CMA, Çakır T, Doğan ŞK, Arslan H. Effects of robotic rehabilitation on motor functions in children with cerebral palsy. Meandros Medical and Dental Journal. 2018;19(3):211.
32. Yaşar B, Atıcı E, Razaei DA, Saldıran TÇ. Effectiveness of robot-assisted gait training on functional skills in children with cerebral palsy. Journal of Pediatric Neurology. 2021;20(03):164-70.
33. TARAKCI D, Ahmet E, AVCIL E, TARAKCI E. Effect of robot assisted gait training on motor performance in cerebral palsy: a pilot study. Journal of Exercise Therapy and Rehabilitation. 2019;6(3):156-62.
34. Drużbicki M, Rusek W, Szczepanik M, Dudek J, Snela S. Assessment of the impact of orthotic gait training on balance in children with cerebral palsy. Acta Bioeng Biomech. 2010;12(3):53-8.
35. Gilliaux M, Renders A, Dispa D, Holvoet D, Sapin J, Dehez B, et al. Upper limb robot-assisted therapy in cerebral palsy: a single-blind randomized controlled trial. Neurorehabilitation and neural repair. 2015;29(2):183-92.
36. van Hedel HJ, Meyer-Heim A, Rüsch-Bohtz C. Robot-assisted gait training might be beneficial for more severely affected children with cerebral palsy. Developmental neurorehabilitation. 2016;19(6):410-5.

37. Smania N, Bonetti P, Gandolfi M, Cosentino A, Waldner A, Hesse S, et al. Improved gait after repetitive locomotor training in children with cerebral palsy. American journal of physical medicine & rehabilitation. 2011;90(2):137-49.
38. Dewar R, Love S, Johnston LM. Exercise interventions improve postural control in children with cerebral palsy: a systematic review. Developmental Medicine & Child Neurology. 2015;57(6):504-20.
39. Llamas-Ramos R, Sánchez-González JL, Llamas-Ramos I. Robotic systems for the physiotherapy treatment of children with cerebral palsy: a systematic review. International Journal of Environmental Research and Public Health. 2022;19(9):5116.
40. Cherni Y, Ziane C. A narrative review on robotic-assisted gait training in children and adolescents with cerebral palsy: training parameters, choice of settings, and perspectives. Disabilities. 2022;2(2):293-303.
41. Volpini M, Aquino M, Holanda AC, Emygdio E, Polese J. Clinical effects of assisted robotic gait training in walking distance, speed, and functionality are maintained over the long term in individuals with cerebral palsy: A systematic review and meta-analysis. Disability and Rehabilitation. 2022;44(19):5418-28.
42. Bonanno M, Militi A, La Fauci Belponer F, De Luca R, Leonetti D, Quartarone A, et al. Rehabilitation of Gait and Balance in Cerebral Palsy: A Scoping Review on the Use of Robotics with Biomechanical Implications. Journal of Clinical Medicine. 2023;12(9):3278.
43. Akyol B, Güllü M. SEREBRALPALSİLİ ÇOCUKLARDA ELBECERİLERİNİN KABA MOTOR SEVİYEYE VE ÖZÜRLÜLÜK DURUMUNA ETKİSİNİN İNCELENMESİ. İnönü Üniversitesi Sağlık Hizmetleri Meslek Yüksek Okulu Dergisi. 2014;2(1):22-30.
44. Chen Y-P, Howard AM. Effects of robotic therapy on upper-extremity function in children with cerebral palsy: a systematic review. Developmental neurorehabilitation. 2016;19(1):64-71.
45. Fasoli SE, Fragala-Pinkham M, Hughes R, Hogan N, Krebs HI, Stein J. Upper limb robotic therapy for children with hemiplegia. American journal of physical medicine & rehabilitation. 2008;87(11):929-36.
46. Masia L, Frascarelli F, Morasso P, Di Rosa G, Petrarca M, Castelli E, et al. Reduced short term adaptation to robot generated dynamic environment in children affected by Cerebral Palsy. Journal of neuroengineering and rehabilitation. 2011;8:1-13.
47. Wood KC, Lathan CE, Kaufman KR. Feasibility of gestural feedback treatment for upper extremity movement in children with cerebral palsy. IEEE Transactions on Neural Systems and Rehabilitation Engineering. 2012;21(2):300-5.
48. El-Shamy SM. Efficacy of Armeo® robotic therapy versus conventional therapy on upper limb function in children with hemiplegic cerebral palsy. American journal of physical medicine & rehabilitation. 2018;97(3):164-9.
49. Fasoli SE, Fragala-Pinkham M, Hughes R, Krebs HI, Hogan N, Stein J. Robotic therapy and botulinum toxin type A: a novel intervention approach for cerebral palsy. American journal of physical medicine & rehabilitation. 2008;87(12):1022-6.
50. Frascarelli F, Masia L, Di Rosa G, Cappa P, Petrarca M, Castelli E, et al. The impact of robotic rehabilitation in children with acquired or congenital movement disorders. European journal of physical and rehabilitation medicine. 2009;45(1):135-41.
51. Turconi AC, Biffi E, Maghini C, Peri E, Gagliardi C. Can new technologies improve upper limb performance in grown-up diplegic children? European Journal of Physical and Rehabilitation Medicine. 2015;52(5):672-81.

52. Bishop L, Gordon AM, Kim H. Hand robotic therapy in children with hemiparesis: a pilot study. American Journal of Physical Medicine & Rehabilitation. 2017;96(1):1-7.
53. Gilliaux M, Dispa D, Renders A, Holvoet D, Sapin J, Dehez B, et al. Effectiveness of an interactive robot for the rehabilitation of the upper limb in children with cerebral palsy: a randomised single-blind controlled trial. Annals of Physical and Rehabilitation Medicine. 2013(56):e293.
54. Kuo F-L, Lee H-C, Hsiao H-Y, Lin J-C. Robotic-assisted hand therapy for improvement of hand function in children with cerebral palsy: a case series study. European Journal of Physical and Rehabilitation Medicine. 2020;56(2):237-42.
55. Picelli A, La Marchina E, Vangelista A, Chemello E, Modenese A, Gandolfi M, et al. Effects of robot-assisted training for the unaffected arm in patients with hemiparetic cerebral palsy: a proof-of-concept pilot study. Behavioural neurology. 2017;2017.
56. Krebs HI, Fasoli SE, Dipietro L, Fragala-Pinkham M, Hughes R, Stein J, et al. Motor learning characterizes habilitation of children with hemiplegic cerebral palsy. Neurorehabilitation and neural repair. 2012;26(7):855-60.
57. Roberts H, Shierk A, Clegg NJ, Baldwin D, Smith L, Yeatts P, et al. Constraint induced movement therapy camp for children with hemiplegic cerebral palsy augmented by use of an exoskeleton to play games in virtual reality. Physical & Occupational Therapy In Pediatrics. 2020;41(2):150-65.
58. Biffi E, Maghini C, Cairo B, Beretta E, Peri E, Altomonte D, et al. Movement velocity and fluidity improve after Armeo® Spring rehabilitation in children affected by acquired and congenital brain diseases: an observational study. BioMed Research International. 2018;2018.
59. Cimolin V, Germiniasi C, Galli M, Condoluci C, Beretta E, Piccinini L. Robot-assisted upper limb training for hemiplegic children with cerebral palsy. Journal of Developmental and Physical Disabilities. 2019;31:89-101.
60. Fluet GG, Qiu Q, Kelly D, Parikh HD, Ramirez D, Saleh S, et al. Interfacing a haptic robotic system with complex virtual environments to treat impaired upper extremity motor function in children with cerebral palsy. Developmental neurorehabilitation. 2010;13(5):335-45.
61. Jannink MJ, Van Der Wilden GJ, Navis DW, Visser G, Gussinklo J, Ijzerman M. A low-cost video game applied for training of upper extremity function in children with cerebral palsy: a pilot study. Cyberpsychology & behavior. 2008;11(1):27-32.
62. Qiu Q, Ramirez DA, Saleh S, Fluet GG, Parikh HD, Kelly D, et al. The New Jersey Institute of Technology Robot-Assisted Virtual Rehabilitation (NJIT-RAVR) system for children with cerebral palsy: a feasibility study. Journal of neuroengineering and rehabilitation. 2009;6:1-10.
63. Fahr A, Keller JW, Van Hedel HJ. A systematic review of training methods that may improve selective voluntary motor control in children with spastic cerebral palsy. Frontiers in Neurology. 2020;11:572038.
64. Sajan JE, John JA, Grace P, Sabu SS, Tharion G. Wii-based interactive video games as a supplement to conventional therapy for rehabilitation of children with cerebral palsy: a pilot, randomized controlled trial. Developmental neurorehabilitation. 2017;20(6):361-7.
65. Acar G, Altun GP, Yurdalan S, Polat MG. Efficacy of neurodevelopmental treatment combined with the Nintendo® Wii in patients with cerebral palsy. Journal of physical therapy science. 2016;28(3):774-80.

66. Wu J, Loprinzi PD, Ren Z. The Rehabilitative effects of virtual reality games on balance performance among children with cerebral palsy: A meta-analysis of randomized controlled trials. International journal of environmental research and public health. 2019;16(21):4161.
67. Warnier N, Lambregts S, Port IVD. Effect of virtual reality therapy on balance and walking in children with cerebral palsy: A systematic review. Developmental neurorehabilitation. 2020;23(8):502-18.