

İNME REHABİLTASYONU

17.

BÖLÜM

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Giriş

İnme beyin kan akımının aniden azalması veya durmasıyla meydana gelen motor kontrol ve duyusal fonksiyon kaybı, denge problemleri, konuşma ve kognitif fonksiyon kaybı, görme bozuklarından komaya kadar gidebilen klinik bir tablodur (1-2). Dünya Sağlık Örgütü tarafından inme, vasküler kaynaklı olup ölüme sebebiyet verebilen veya hızla gelişen ve 24 saatten daha uzun süren serebral fonksiyonların bozulması nedeniyle ortaya çıkan fokal veya yaygın klinik tablo olarak tanımlanmaktadır (3).

Serebrovasküler hastalıkların insidansı ülkelere göre değişmekte beraber son verilere göre dünya genelinde 100000'de 258, ülkemizde ise 100000'de 177 kişi olduğu bildirilmektedir. İnme ülkemizde de dünyada olduğu gibi ölüm nedenleri arasında 2. sırada engellilik nedenleri arasında 3. sırada yer almaktadır (4, 5).

İnme insidansı ilerleyen yaşla birlikte artış göstermekle beraber erkek cinsiyette daha sık görülmektedir (6).

Beklenen yaşam süresi tüm dünyada artmaktadır. Gelişen tedavi yöntemleri ile birlikte SVO sonrası sağkalım oranlarının artması bu süreçte katkıda bulunmuştur. İnme rehabilitasyonunda amaç bireye en yüksek seviyede fonksiyonel

bağımsızlığı kazandırabilmek ve yaşam kalitesini artırmaktır. Rehabilitasyon programında hasta ile beraber, hastanın ailesi ve bakıcısı da sürece dahil edilmelidir (2).

1.Risk Faktörleri

İnme risk faktörleri açısından iyi bilinen bir klinik tablodur. Bu nedenle risk faktörlerini analiz ederek inmenin ortaya çıkışmasını engellemek çok önemlidir. Yaş, cinsiyet, ırk ve genetik gibi değiştirilemeyen risk faktörleri olmakla beraber bir kısmı da değiştirilebilir özellikle (7).

Hipertansiyon değiştirilebilen risk faktörleri arasında bilinen en önemli risk faktördür. Normotansif hastalardan farklı olarak hipertansif hastalarda serebral infarkt 7 kat daha sık tespit edilmiştir (8).

Atrial fibrilasyon (AF) olan hastalarda iskeletik inme riskinin 5 kat arttığı saptanmış olup antikoagulan tedavi ile beraber bu riskin azaldığı gösterilmiştir (9).

Diyabetes mellituslu hastalarda inme riski 2,5 kat daha fazladır (10). Diyabet bir zamanlar laküner infarkt için risk faktörü olarak düşünülse de artık genel anlamda iskemik inme ile ilişkili olduğu gösterilmiştir. Ayrıca hipertansiyon, lipid bozuklukları, sigara ve AF gibi klasik risk faktör-

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rında konvansiyonel rehabilitasyon yöntemlerine kıyasla daha anlamlı bir iyileşme sağladığı belirtilmiştir (106).

9. İnme Rehabilitasyon Sonuçları, Prognoz ve İzlem

Hastalarda rehabilitasyon sürecinin olası sonuçlarının ve prognozun tahmini çok önemlidir. Buna göre hasta ve ailesi bilgilendirilir, uygun rehabilitasyon yöntemleri belirlenir ve hastanın kronik dönemde izlemi planlanmalıdır (2).

Rehabilitasyondan sonra hastalarda fiziksel performans, fonksiyonel yetenek ve yaşam kalitesinde önemli gelişmeler kaydedilebilir. Geniş ve kapsamlı bir çalışma olan Framingham çalışmasında inmeli hastaların %69' u kişisel bakım aktivitelerinde, %80'i de mobilizasyonda bağımsızlık kazandığı belirtilmiştir (107).

Yapılan bir derlemede koma varlığı, kognitif fonksiyonlarda bozukluk, ciddi hemipleji, tekrarlayan inme atakları, inatçı inkontinans, ihmal sendromu, algusal yetilerde kayıp, motor fonksiyonlarda düzelmenin 1 ay içinde başlamaması, önemli bir KVS hastalığının bulunması, serebral lezyonun büyük olması ve birden fazla nörolojik bozukluk olması gibi faktörler varlığında prognozun kötü olacağını savunmuşlardır (108).

İnme sonrası hastalar ko-morbid problemler açısından detaylı irdelenmeli ve olabildiğince erken dönemde rehabilitasyon programına alınmalıdır. Özellikle ilk 6 ay-1 yıllık süreç hastanın fonksiyonellik kazanması açısından ciddi öneme sahiptir. İnme hastalarında engellilik takibi açısından da bu süreler dikkate alınmalıdır. Engellilik kararı için rehabilitasyonda ulaşılan maksimum fonksiyonellik durumu göz önüne alınmalıdır. Ancak en az 6 ay- 1 yıl süre ile rehabilitasyon sonrası değerlendirme daha doğru yol gösterecektir.

KAYNAKLAR

1. Türk Nöroloji Derneği (TND). *2014 Beyin Yılı Aktiviteleri*, Yayın yönetmeni: Prof. Dr. Rana Karabudak. (Erişim tarihi:21.09.2020, www.nuroloji.org.tr)
2. Çevikol A, Çakıcı A. (2015). İnme Rehabilitasyonu. Hasan Oğuz (Ed.), *Tıbbi Rehabilitasyon* üçüncü baskı (s. 419-48). İstanbul: Nobel Tıp Kitapevleri.
3. Vereshchagin NV, Sartorius N, Orgogozo JM et al. Stroke--1989. Recommendations on stroke prevention, diagnosis, and therapy. Report of the WHO task force on stroke and other cerebrovascular disorders. *Stroke; A Journal of Cerebral Circulation* 1989;20(10):1407-31. Doi: 10.1161/01.str.20.10.1407.
4. Johnson W, Onuma O, Owolabi M et al. Stroke: a global response is needed. *Bulletin of the World Health Organization*. 2016;94(9):634-634A. Doi:10.2471/BLT.16.181636.
5. Arsava M. Beyin damar hastalıkları ve demans. Ulusal hastalık yükü çalışması sonuçları ve çözüm önerileri, Hacettepe Üniversitesi Tıp Fakültesi. 18 Nisan 2017 (s. 9).
6. Béjot Y, Bailly H, Durier J et al. Epidemiology of stroke in Europe and trends for the 21st century. *La Presse Médicale* 2016;45(12):391-98. Doi: 10.1016/j.lpm.2016.10.003.
7. Karataş GK. (2016). İnme Rehabilitasyonu. Mehmet Beyazova, Yeşim Gökçe Kutsal (Eds). *Fiziksel Tıp ve Rehabilitasyon üçüncü baskı* (s. 2267-2390). Ankara: Güneş Tıp Kitapevleri.
8. Kannel WB, Dawber TR, Sorlie P et al. Components of blood pressure and risk of atherothrombotic brain infarction: The Framingham study. *Stroke* 1976;7:327-31. Doi:10.1161/01.STR.7.4.327.
9. Marinigh R, Gregory YH, Fiotti N et al. Age as a risk factor for stroke in atrial fibrillation patients: implications for thromboprophylaxis. *Journal of the American College of Cardiology* 2010;56(11):827-837. Doi: 10.1016/j.jacc.2010.05.028.
10. Kothari V, Stevens RJ, Adler AI et al. UKPDS 60: Risk of stroke in type 2 diabetes estimated by the UK Prospective Diabetes Study risk engine. *Stroke* 2002;33(7):1776-81.
11. Barrett-Connor E, Kay-Tee K. Diabetes mellitus: an independent risk factor for stroke?. *American journal of epidemiology* 1988;128(1):116-23. Doi:10.1093/oxfordjournals.aje.a114934.
12. Shah RS, Cole JW. Smoking and stroke: the more you smoke the more you stroke. *Expert review of cardiovascular therapy* 2010;8(7):917-32. Doi:10.1586/erc.10.56.
13. Shah S, Vanclay F, Cooper B. Improving the sensitivity of the Barthel Index for stroke rehabilitation. *Journal of clinical epidemiology* 1989;42(8):703-9.
14. Kucukdeveci AA, Yavuzer G, Tennant A et al. Adaptation of the modified Barthel Index for use in physical medicine and rehabilitation in Turkey. *Scandinavian journal of rehabilitation medicine* 2000;32(2): 87-92.
15. Choi JC, Kim BJ, Han MK et al. Utility of Items of Baseline National Institutes of Health Stroke Scale as Predictors of Functional Outcomes at Three Months after

- Mild Ischemic Stroke. *Journal of Stroke and Cerebrovascular Diseases* 2017;26(6):1306-13.
16. Cook L, Smith DS, Truman G. Using functional independence measure profiles as an index of outcome in the rehabilitation of brain-injured patients. *Archives of Physical Medicine and Rehabilitation* 1994;75(4):390-3.
 17. Küçükdeveci AA, Yavuzer G, Elhan AH et al. Adaptation of the functional independence measure for use in Turkey. *Clinical Rehabilitation* 2001;15(3):311-9.
 18. Küçükdeveci AA, Tennant A, Grimby G et al. Strategies for assessment and outcome measurement in physical and rehabilitation medicine: an educational review. *J Rehabil Med* 2011;43(8):661-72. Doi: 10.2340/16501977-0844.
 19. Küçükdeveci AA, McKenna SP, Kutlay S et al. The development and psychometric assessment of the Turkish version of the Nottingham Health Profile. *International Journal of Rehabilitation Research*. 2000;23(1):31-8.
 20. Gottesman RF, Hillis AE. Predictors and assessment of cognitive dysfunction resulting from ischaemic stroke. *The Lancet Neurology*. 2010;9(9):895-905. Doi: 10.1016/S1474-4422(10)70164-2.
 21. Dick JPR, Guiloff RJ, Stewart A et al. Mini-mental state examination in neurological patients. *Journal of Neurology, Neurosurgery & Psychiatry* 1984;47(5): 496-9.
 22. O'Sullivan M, Morris RG, Markus HS. Brief cognitive assessment for patients with cerebral small vessel disease. *Journal of Neurology, Neurosurgery & Psychiatry* 2005;76(8):1140-5. Doi: 10.1136/jnnp.2004.045963.
 23. Elhan A, Kutlay S, Küçükdeveci A et al. Psychometric properties of the Mini-Mental State Examination in patients with acquired brain injury in Turkey. *Journal of Rehabilitation Medicine* 2005;37(5):306-11. Doi:10.1080/16501970510037573.
 24. Tanrıdağ O. Mental Durum Testleri. Ankara, GATA Basimevi. 1992; s. 57-66.
 25. Nielsen JA, Zielinski BA, Ferguson MA et al. An evaluation of the left-brain vs. right-brain hypothesis with resting state functional connectivity magnetic resonance imaging. *PloS one* 2013;8(8):e71275. Doi: 10.1371/journal.pone.0071275.
 26. Al-Qazzaz NK, Sawal HA, Siti AA et al. Cognitive impairment and memory dysfunction after a stroke diagnosis: a post-stroke memory assessment. *Neuropsychiatric disease and treatment* 2014;10:1677-91. Doi:10.2147/NDT.S67184.
 27. Chen P, Hreha K, Kong Y et al. Impact of spatial neglect on stroke rehabilitation: evidence from the setting of an inpatient rehabilitation facility. *Archives of physical medicine and rehabilitation* 2015;96(8):1458-66.
 28. Bowen A, Hazelton C, Pollock A et al. Cognitive rehabilitation for spatial neglect following stroke. *Cochrane Database of Systematic Reviews* 2013;1(7):CD003586. Doi: 10.1002/14651858.CD003586.pub3.
 29. Buxbaum LJ, Haaland KY, Hallett M et al. Treatment of limb apraxia: moving forward to improved action. *American Journal of Physical Medicine & Rehabilitation* 2008;87(2):149-61.
 30. Vanbellingen T, Kersten B, Van Hemelrijck B et al. Comprehensive assessment of gesture production: a new test of upper limb apraxia (TULIA). *European Journal of Neurology* 2010;17(1):59-66. Doi:10.1111/j.1468-1331.2009.02741.x.
 31. Pedersen PM, Jorgensen HS, Kammersgaard LP et al. Manual and oral apraxia in acute stroke, frequency and influence on functional outcome: The Copenhagen Stroke Study. *American journal of physical medicine & rehabilitation* 2001;80(9):685-92. Doi:10.1097/00002060-200109000-00008.
 32. Berthier ML. Poststroke aphasia. *Drugs & aging* 2005;22(2):163-82. Doi:10.2165/00002512-200522020-00006.
 33. Ferro JM, Mariano G, Madureira S. Recovery from aphasia and neglect. *Cerebrovascular diseases* 1999;9(5):6-22.
 34. Enderby P, Crow E. Frenchay aphasia screening test: validity and comparability. *Disability and Rehabilitation* 1996;18(5):238-40. Doi: 10.3109/09638289609166307.
 35. Borod JC, Goodglass H, Kaplan E. Normative data on the boston diagnostic aphasia examination, parietal lobe battery and the boston naming test. *Journal of Clinical and Experimental Neuropsychology* 1980;2(3):209-15. Doi:10.1080/01688638008403793.
 36. Maviş İ, Colay K, Topbaş S et al. Gülhane afazi testi-2'nin standartizasyon ve geçerlik-güvenirlilik çalışması. *Turkish Journal of Neurology*. 2007;13(2):89-98.
 37. Elsner B, Kugler J, Pohl M et al. Transcranial direct current stimulation (tDCS) for improving aphasia in adults with aphasia after stroke. *Cochrane database of systematic reviews* 2019;5:CD009760. Doi: 10.1002/14651858.CD009760.pub4.
 38. Ozyemisci-Taskiran O, Gunendi Z, Aknar O et al. Revisiting length of stay in stroke rehabilitation in Turkey. *Archives of physical medicine and rehabilitation* 2011;92(2):257-64. Doi:10.1016/j.apmr.2010.08.017.
 39. Gladstone DJ, Danells CJ, Black SE. The Fugl-Meyer assessment of motor recovery after stroke: a critical review of its measurement properties. *Neurorehabilitation and neural repair* 2002;16(3):232-40.
 40. Charalambous CP. (2014) Interrater reliability of a modified Ashworth scale of muscle spasticity. Banaszkiewicz P, Kader D (Eds). *Classic papers in orthopaedics (pp415-7)*. London: Springer. Doi:10.1007/978-1-4471-5451-8_105.
 41. Blum L, Korner-Bitensky N. Usefulness of the Berg Balance Scale in stroke rehabilitation: a systematic review. *Physical therapy* 2008;88(5):559-66. Doi:10.2522/ptj.20070205.
 42. Au-Yeung SS, Ng JT, Lo SK. Does balance or motor impairment of limbs discriminate the ambulatory status of stroke survivors? *American journal of physical medicine & rehabilitation* 2003;82(4):279-83. Doi:10.1097/01.PHM.0000056988.24854.8D.
 43. Verheyden G, Vereeck L, Truijen S. Trunk performance after stroke and the relationship with balance, gait and functional ability. *Clinical rehabilitation* 2006;20(5):451-8. Doi:10.1191/0269215505cr955oa.
 44. Leppävuori A, Pohjasvaja T, Vataja R et al. Insomnia

- in ischemic stroke patients. *Cerebrovascular diseases* 2002;14(2):90-9. Doi:10.1159/000064737.
45. Sterr A, Herron K, Dijk DJ et al. Time to wake-up: sleep problems and daytime sleepiness in long-term stroke survivors. *Brain Injury* 2008;22(7-8):575-9. Doi:10.1080/02699050802189727.
 46. Bishop DS, Pet R. Psychobehavioral problems other than depression in stroke. *Topics in stroke rehabilitation* 1995;2(2):56-68. Doi:10.1080/10749357.1995.11754070.
 47. Ingles JL, Eskes GA, Phillips SJ. Fatigue after stroke. *Archives of physical medicine and rehabilitation* 1999;80(2):173-8. Doi:10.1016/s0003-9993(99)90116-8.
 48. Umay EK, Unlu E, Saylam GK et al. Evaluation of dysphagia in early stroke patients by bedside, endoscopic, and electrophysiological methods. *Dysphagia* 2013;28(3):395-403. Doi: 10.1007/s00455-013-9447-z.
 49. Cook IJ, Kahrilas PJ. AGA technical review on management of oropharyngeal dysphagia. *Gastroenterology* 1999;116(2):455-78. Doi:10.1016/S0016-5085(99)70144-7.
 50. Gomes F, Emery PW, Weekes CE. Risk of malnutrition is an independent predictor of mortality, length of hospital stay, and hospitalization costs in stroke patients. *Journal of Stroke and Cerebrovascular Diseases* 2016;25(4):799-806. Doi:10.1016/j.jstrokecerebrovasdis.2015.12.017.
 51. Paolucci S. Epidemiology and treatment of post-stroke depression. *Neuropsychiatric disease and treatment* 2008;4(1):145-54. Doi:10.2147/ndt.s2017.
 52. Robinson RG, Spalletta G. Poststroke depression: a review. *The Canadian Journal of Psychiatry* 2010;55(6):341-9. Doi:10.1177/070674371005500602.
 53. Hackett ML, Anderson CS. Predictors of depression after stroke: a systematic review of observational studies. *Stroke* 2005;36(10):2296-301. Doi:10.1161/01.STR.0000183622.75135.a4.
 54. Chollet F, Rigal J, Marque P et al. Serotonin selective reuptake inhibitors (SSRIs) and stroke. *Current neurology and neuroscience reports* 2018;18(12):100. Doi:10.1007/s11910-018-0904-9.
 55. Shen X, Liu M, Cheng Y et al. Repetitive transcranial magnetic stimulation for the treatment of post-stroke depression: a systematic review and meta-analysis of randomized controlled clinical trials. *Journal of affective disorders* 2017;211:65-74. Doi:10.1016/j.jad.2016.12.058.
 56. Kerse N, Parag V, Feigin VL et al. Falls after stroke: results from the Auckland Regional Community Stroke (ARCOS) Study, 2002 to 2003. *Stroke* 2008;39(6):1890-3. Doi:10.1161/STROKEAHA.107.509885.
 57. Batchelor F, Hill K, Mackintosh S et al. What works in falls prevention after stroke? A systematic review and meta-analysis. *Stroke* 2010;41(8):1715-22. Doi:10.1161/STROKEAHA.109.570390.
 58. Kim JS. Pharmacological management of central post-stroke pain: a practical guide. *CNS drugs* 2014;28(9):787-97. Doi:10.1007/s40263-014-0194-y.
 59. Kapoor E, Austin PC, Alibhai SMH et al. Screening and treatment for osteoporosis after stroke. *Stroke* 2019;50(6):58-62. Doi:10.1161/STROKEAHA.118.024685.
 60. Carda S, Cisari C, Invernizzi M et al. Osteoporosis after stroke: a review of the causes and potential treatments. *Cerebrovascular diseases* 2009;28(2):191-200. Doi:10.1159/000226578.
 61. Beaupre GS, Lew HL. Bone-density changes after stroke. *American journal of physical medicine & rehabilitation* 2006;85(5):464-72. Doi:10.1097/01.phm.0000214275.69286.7a.
 62. Fisher A, Srikuhanukul W, Davis M et al. Poststroke hip fracture: prevalence, clinical characteristics, mineral-bone metabolism, outcomes, and gaps in prevention. *Stroke research and treatment* Volume2013, Article ID 641943, 17 pages. Doi:10.1155/2013/641943.
 63. Gelber DA, Good DC, Dromerick A et al. Open-label dose-titration safety and efficacy study of tizanidine hydrochloride in the treatment of spasticity associated with chronic stroke. *Stroke* 2001;32(8):1841-6. Doi:10.1161/01.STR.32.8.1841.
 64. Kaji R, Osako Y, Suyama K et al. Botulinum toxin type A in post-stroke upper limb spasticity. *Current medical research and opinion* 2010;26(8):1983-92. Doi:10.1185/03007995.2010.497103.
 65. Karri J, Mas MF, Francisco GE et al. Practice patterns for spasticity management with phenol neurolysis. *J Rehabil Med* 2017;49(6):482-8. Doi: 10.2340/16501977-2239.
 66. Ivanhoe CB, Francisco GE, McGuire JR et al. Intrathecal baclofen management of poststroke spastic hypertonia: implications for function and quality of life. *Archives of physical medicine and rehabilitation* 2006;87(11):1509-15. Doi:10.1016/j.apmr.2006.08.323.
 67. Teasell R, Foley N, Salter K et al. Evidence-based review of stroke rehabilitation: executive summary, 12th edition. *Top Stroke Rehabil.* 2009;16(6):463-88. Doi:10.1310/tsr1606-463.
 68. Kolominsky-Rabas PL, Hilz MJ, Neundoerfer B et al. Impact of urinary incontinence after stroke: results from a prospective population-based stroke register. *Neurorol Urodyn.* 2003;22(4):322-7. Doi:10.1002/nau.10114.
 69. Jørgensen L, Engstad T, Jacobsen BK. Self-reported urinary incontinence in noninstitutionalized long-term stroke survivors: A population-based study. *Archives of physical medicine and rehabilitation* 2005;86(3):416-20. Doi:10.1016/j.apmr.2004.05.011.
 70. Bartzán JJ, Domenech JR, González M. New-onset fecal incontinence after stroke: risk factor or consequence of poor outcomes after rehabilitation? *Stroke* 2003;34(8):e101-02. Doi: 10.1161/01.STR.0000081222.82020.D3.
 71. Camara-Lemarroy CR, Ibarra-Yruegas BE, Gongora-Rivera F. Gastrointestinal complications after ischemic stroke. *Journal of the neurological sciences* 2014;346(1-2):20-5. Doi: 10.1016/j.jns.2014.08.027.
 72. Harari D, Norton C, Lockwood L et al. Treatment of constipation and fecal incontinence in stroke patients:

- randomized controlled trial. *Stroke* 2004;35(11):2549-55. Doi:10.1161/01.STR.0000144684.46826.62.
73. Robertson J, Baines S, Emerson E et al. Constipation management in people with intellectual disability: A systematic review. *J Appl Res Intellect Disabil*. 2018;31(5):709-24. Doi:10.1111/jar.12426.
 74. Nadler M, Pauls M, Cluckie G et al. Shoulder pain after recent stroke (SPARS): hemiplegic shoulder pain incidence within 72 hours post-stroke and 8–10 week follow-up (NCT 02574000). *Physiotherapy* 2019;107:142-9. Doi:10.1016/j.physio.2019.08.003.
 75. Acar M, Karatas GK. The effect of arm sling on balance in patients with hemiplegia. *Gait & posture* 2010;32(4):641-4. Doi: 10.1016/j.gaitpost.2010.09.008.
 76. Ada L, Foongchomcheay A, Canning CG. Supportive devices for preventing and treating subluxation of the shoulder after stroke. *Cochrane database of systematic reviews* 2005;1:CD003863. Doi:10.1002/14651858.CD003863.pub2.
 77. Ada L, Foongchomcheay A. Efficacy of electrical stimulation in preventing or reducing subluxation of the shoulder after stroke: a meta-analysis. *Database of Abstracts of Reviews of Effects (DARE):Quality-assessed Reviews [Internet]*. Review published: 2002.
 78. Tubay A, Bal S, Bayram KB et al. Hemiplejik ağrılı omuzda supraskapular sinir blokajı ve glenohumeral eklem enjeksiyonu: ağrı ve özürlülük üzerindeki etkilerinin karşılaştırılması. *Turk J Phys Med Rehab* 2012;58(4):299-303. Doi:10.4274/tftr.54771.
 79. Ozcan DS, Tatli HU, Polat CS et al. The effectiveness of fluidotherapy in poststroke complex regional pain syndrome: A randomized controlled study. *Journal of Stroke and Cerebrovascular Diseases* 2019;28(6):1578-85. Doi: 10.1016/j.jstrokecerebrovasdis.2019.03.002.
 80. Kalita J, Vajpayee A, Misra UK. Comparison of prednisolone with piroxicam in complex regional pain syndrome following stroke: a randomized controlled trial. *Qjm* 2006;99(2):89-95. Doi:10.1093/qjmed/hcl004.
 81. Tyson SF, Sadeghi-Demneh E, Nester CJ. A systematic review and meta-analysis of the effect of an ankle-foot orthosis on gait biomechanics after stroke. *Clinical Rehabilitation* 2013;27(10):879-91. Doi: 10.1177/0269215513486497.
 82. Kuan TS, Tsou JY, Su FC. Hemiplegic gait of stroke patients: the effect of using a cane. *Archives of physical medicine and rehabilitation* 1999;80(7):777-84. Doi: 10.1016/s0003-9993(99)90227-7.
 83. Balaban B, Tok F. Gait disturbances in patients with stroke. *PM&R* 2014;6(7):635-42. Doi:10.1016/j.pmrj.2013.12.017.
 84. Mulroy S, Gronley J, Weiss W et al. Use of cluster analysis for gait pattern classification of patients in the early and late recovery phases following stroke. *Gait & posture* 2003;18(1):114-25. Doi:10.1016/s0966-6362(02)00165-0.
 85. Ada L, Dean CM, Morris ME et al. Randomized trial of treadmill walking with body weight support to establish walking in subacute stroke: the MOBILISE trial. *Stroke* 2010;41(6):1237-42. Doi:10.1161/STROKEAHA.109.569483.
 86. Hebert D, Lindsay MP, McIntyre A et al. Canadian stroke best practice recommendations: stroke rehabilitation practice guidelines, update 2015. *International Journal of Stroke* 2016;11(4):459-84. Doi: 10.1177/1747493016643553.
 87. Bayouk JF, Boucher JP, Alain L. Balance training following stroke: effects of task-oriented exercises with and without altered sensory input. *International Journal of Rehabilitation Research* 2006;29(1):51-9. Doi:10.1097/01.mrr.0000192100.67425.84.
 88. Ceceli E, Dursun E, Cakci A. Comparison of joint-position biofeedback and conventional therapy methods in genu recurvatum after stroke-6 months' follow-up. *European journal of physical medicine & rehabilitation* 1996;6(5):141-4.
 89. Allen JL, Ting LH, Kesar TM. Gait rehabilitation using functional electrical stimulation induces changes in ankle muscle coordination in stroke survivors: a preliminary study. *Frontiers in neurology* 2018;9:1127. Doi: 10.3389/fneur.2018.01127.
 90. Bogataj U, Gros N, Kljajić M et al. The rehabilitation of gait in patients with hemiplegia: a comparison between conventional therapy and multichannel functional electrical stimulation therapy. *Physical therapy* 1995;75(6):490-502. Doi: 10.1093/ptj/75.6.490.
 91. Berenpas F, Geurts AC, Boer JD et al. Surplus value of implanted peroneal functional electrical stimulation over ankle-foot orthosis for gait adaptability in people with foot drop after stroke. *Gait & posture* 2019;71:157-62. Doi: 10.1016/j.gaitpost.2019.04.020.
 92. Pongpipatpaiboon K, Mukaino M, Matsuda F et al. The impact of ankle-foot orthoses on toe clearance strategy in hemiparetic gait: a cross-sectional study. *Journal of neuroengineering and rehabilitation* 2018;15(1): 41. Doi:10.1186/s12984-018-0382-y.
 93. Mehrholz J, Thomas S, Werner C et al. Electromechanical-assisted training for walking after stroke. *Cochrane Database of Systematic Reviews* 2017;5:CD006185. Doi: 10.1002/14651858.CD006185.pub4.
 94. Bower KJ, Clark RA, McGinley JL et al. Clinical feasibility of the Nintendo Wii™ for balance training post-stroke: a phase II randomized controlled trial in an inpatient setting. *Clinical rehabilitation* 2014;28(9):912-23. Doi:10.1177/0269215514527597.
 95. Darekar A, McFadyen BJ, Lamontagne A et al. Efficacy of virtual reality-based intervention on balance and mobility disorders post-stroke: a scoping review. *Journal of neuroengineering and rehabilitation* 2015;12(1):46. Doi: 10.1186/s12984-015-0035-3.
 96. Sezer N, Yavuzer G, Sivrioglu K et al. Clinimetric properties of the Duruož hand index in patients with stroke. *Archives of physical medicine and rehabilitation* 2007;88(3):309-14. Doi:10.1016/j.apmr.2006.12.019.
 97. Shim S, Kim H, Jung J. Comparison of upper extremity motor recovery of stroke patients with actual physical activity in their daily lives measured with accelerometers. *Journal of physical therapy science* 2014;26(7):1009-11. Doi:10.1589/jpts.26.1009.
 98. Wolf SL, Winstein CJ, Miller JP et al. Effect of constraint-induced movement therapy on upper extremity

- function 3 to 9 months after stroke: the EXCITE randomized clinical trial. *Jama* 2006;296(17):2095-104. Doi: 10.1001/jama.296.17.2095.
99. Taub E, Uswatte G, King DK et al. A placebo-controlled trial of constraint-induced movement therapy for upper extremity after stroke. *Stroke* 2006;37(4):1045-49. Doi:10.1161/01.STR.0000206463.66461.97.
100. Price CI, Pandyan AD. Electrical stimulation for preventing and treating post-stroke shoulder pain: a systematic Cochrane review. *Clinical rehabilitation* 2001;15(1): 5-19. Doi:10.1191/026921501670667822.
101. Eraifej J, Clark W, France B et al. Effectiveness of upper limb functional electrical stimulation after stroke for the improvement of activities of daily living and motor function: a systematic review and meta-analysis. *Systematic reviews* 2017;6(1):40. Doi:10.1186/s13643-017-0435-5.
102. Ramachandran VS, Rogers-Ramachandran D. Synesthesia in phantom limbs induced with mirrors. *Proceedings of the Royal Society of London. Series B: Biological Sciences* 1996;263(1369):377-86. Doi:10.1098/rspb.1996.0058.
103. Toh SF, Fong KN. Systematic review on the effectiveness of mirror therapy in training upper limb hemiparesis after stroke. *Hong Kong Journal of Occupational Therapy* 2012;22(2):84-95.
104. Celnik P, Hummel F, Harris-Love M et al. Somatosensory stimulation enhances the effects of training functional hand tasks in patients with chronic stroke. *Archives of physical medicine and rehabilitation* 2007;88(11):1369-76. Doi: 10.1016/j.apmr.2007.08.001.
105. Mehrholz J, Hädrich A, Platz T et al. Electromechanical and robot-assisted arm training for improving generic activities of daily living, arm function, and arm muscle strength after stroke. *Cochrane database of systematic reviews* 2012;13(6):CD006876. Doi:10.1002/14651858.CD006876.pub3.
106. Kiper P, Agostini M, Luque-Moreno C et al. Reinforced feedback in virtual environment for rehabilitation of upper extremity dysfunction after stroke: preliminary data from a randomized controlled trial. *BioMed research international* 2014;2014:752128. Doi:10.1155/2014/752128.
107. Garraway WM, Whisnant JP, Drury I. The changing pattern of survival following stroke. *Stroke* 1983;14(5):699-703. Doi:10.1161/01.str.14.5.699.
108. Dombovy ML, Sandok BA, Basford JR. Rehabilitation for stroke: a review. *Stroke* 1986;17(3):363-69. Doi: 10.1161/01.STR.17.3.363.