Executive Summary

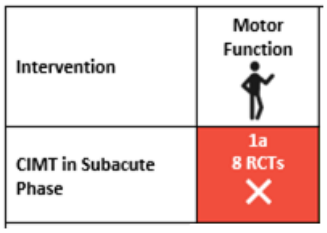
Evidence based review of stroke rehabilitation (EBRSR) 19TH Edition

Robert Teasell MD FRCPC, Jerome Iruthayarajah MSc, Marcus Saikaley HBSc, Mitchell Longval BSC

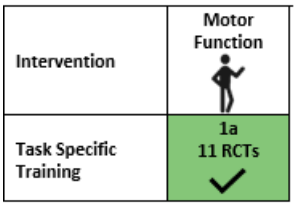
How to read the evidence tables:

The results of each randomized controlled trial (RCT) are split by outcome measure, and findings are presented for those studies comparing an intervention to conventional therapy.

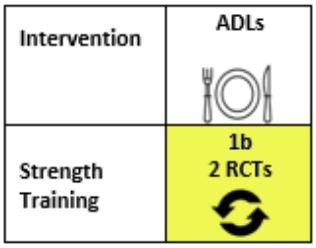
Red statements indicate that the majority of study results when grouped together show no significant differences between intervention and comparator groups, pre to post intervention.



Green statements indicate that the majority of study results when grouped together show a significant between group difference in favour of the intervention group, pre to post intervention.



Yellow statements indicate that the study results when grouped together are mixed or conflicting, some studies show benefit in favour of the intervention group, while others show no difference between groups, pre to post intervention.



Evidence statements are based upon a **Modified Sackett Scale**:

Level of evidence	**Study design**	**Description**
Level 1a	Randomized controlled trial (RCT)	More than 1 higher quality RCT (PEDro score ≥6).
Level 1b	RCT	1 higher quality RCT (PEDro score ≥6).
Level 2	RCT	Lower quality RCT (PEDro score <6).
	Prospective controlled trial (PCT)	PCT (not randomized).
	Cohort	Prospective longitudinal study using at least 2 similar groups with one exposed to a particular condition.
Level 3	Case Control	A retrospective study comparing conditions, including historical cohorts.
Level 4	Pre-Post	A prospective trial with a baseline measure, intervention, and a post-test using a single group of subjects.
	Post-test	A prospective post-test with two or more groups (intervention followed by post-test and no re-test or baseline measurement) using a single group of subjects
	Case Series	A retrospective study usually collecting variables from a chart review.
Level 5	Observational	Study using cross-sectional analysis to interpret relations. Expert opinion without explicit critical appraisal, or based on physiology, biomechanics or "first principles".
	Case Report	Pre-post or case series involving one subject.

1.Brain Reorganization, Recovery and Organized Care

(Evidence Review Chapters 5-7 and Clinician's Handbook Chapter 2)

Measures of Functional Outcomes

Category	Rationale	Individual Assessment Tools
Stroke severity 	These outcome measures assessed the severity of one's stroke through a global assessment of a multitude of deficits a stroke survivor may experience.	• Canadian Neurological Scale (CNS) • Modified Rankin Scale (MRS) • National Institutes of Health Stroke Scale (NIHSS) • Oxford Handicap Scale • Scandinavian Stroke Scale (SSS)
Activities of Daily Living 	These outcome measures assessed performance and level of independence in various everyday tasks.	• Barthel Index (BI) • Canadian Occupational Performance Measure (COPM) • Frenchay Activities Index (FAI) • Functional Independence Measure (FIM) • Motor Assessment Scale (MAS) • Nottingham Extended Activities of Daily Living • Rivermead Activities of Daily Living • Stroke Impact Scale (SIS)
Motor function 	These outcome measures covered gross motor movements and a series of general impairment measures when using the upper extremities.	• Action Research Arm Test (ARAT) • Fugl-Meyer Assessment (FMA) • Nine Hole Peg Test (9HPT) • Wolf Motor Function Test (WMFT)
Ambulation and mobility 	These outcomes measures assessed ambulatory abilities during distance-based or timed walking exercises commonly.	• 10-Metre Walk Test • 6-Minute Walk Test • Functional Ambulation Category • Gait Speed • Walking Speed (WS)
Balance 	These outcome measures assessed postural stability, and both static and dynamic balance.	• Berg Balance Scale • Activities-Specific Balance Confidence Scale • Timed Up & Go Test (TUG) •
Cognition 	These outcome measures assessed an individual's overall cognitive processing capability factoring in multiple domains.	• Mini Mental Status Examination (MMSE)
Speech and language 	These outcome measures assessed speech and language outcome measures.	• Frenchay Aphasia Screening Test • Functional Communication Profile • Western Aphasia Battery
Spasticity 	These outcome measures assessed changes in muscle tone, stiffness, and contractures.	• Modified Ashworth Scale (MAS)

Mental Health 	These outcome measures assess psychiatric dysfunction in a number of mental health related dimensions.	• General Health Questionnaire • Beck Depression Inventory (BDI) • Geriatric Depression Scale (GDS) • Hospital Anxiety and Depression Scale (HADS) • Montgomery-Asberg Depression Rating Scale
Quality of Life 	These outcome measures assessed an individual's overall quality of life and their perception of it, generally compared to their preinjury status.	• EuroQol Quality of Life (EQ-5D) • Life Satisfaction Index • Medical Outcome Trusts' Short Form Health Survey (SF-36 or SF-12) • Nottingham Health Profile • Sickness Impact Profile
Community Reintegration 	These outcome measures assess an individual's ability to reintegrate into their community and social behaviours.	• Reintegration to Normal Living Index (RNLI)
Caregiver Burden 	These outcome measures assess the level of burden for caretakers of stroke survivors.	• Caregiver Strain Index
Length of stay 	Assessed how long a patient was admitted to a stroke unit or outpatient service.	
Mortality 	A measure of mortality.	

1a. Organized Stroke Care – Interdisciplinary Care/Team

Randomized Controlled Trials Evaluating All Stroke Care Models

Acute Stroke Care (n=7)	Combined Acute/Rehabilitation (n=7)	Subacute Rehabilitation (n=7)	Mobile Stroke Teams (n=4)
Ronning & Guldvog (1998b)	Garraway et al. (1981)	Peacock et al. (1972)	Dey et al. (2005)
Cabral et al. (2003)	Sivenius et al. (1985)	Stevens et al. (1984)	Wood-Dauphinee et al. (1984a)
Sulter et al. (2003)	Indredavik et al. (1991)	Kalra et al. (1993)	Kalra et al. 2000, (2005)
DiLauro et al. (2003)	Kaste et al. (1995b)	Kalra & Eade (1995)	Hamrin et al. (1982)
Cavallini et al. (2003)	Fagerberg et al. (2000)	Juby et al. (1996)	
Silva et al. (2005)	Ma et al. (2004a)	Ronning & Guldvog (1998b)	
Langhorne et al. (2010b)	Chan et al. (2014)	Yagura et al. (2005)	

Efficacy of Stroke Rehabilitation Organized Care

Acute Rehabilitation Units

Acute Continuous Monitoring Compared to an Alternative Intervention

Study (PEDro Score)	Mortality	Dependency	Length of Stay	Institutionalization
Silva et al. (2005) (3)	✗	✗		
Cavallini et al. (2003) (5)	✗	✗	✓	✓
Sulter et al. (2003) (7)	✓	✗	✓	✗
Langhorne et al. (2010) (8)		✓	✗	

Acute Intensive Rehabilitation Compared to Alternative Intervention

Study (PEDro Score)	Mortality	Dependency	Length of Stay	Institutionalization
Di Lauro et al. (2003) (7)		✗		
Langhorne et al. (2010a) (8)		✓	✗	

Acute Stroke Unit Care Compared to General Medical Ward Care

Study (PEDro Score)	Mortality	Dependency	Length of Stay	Institutionalization
Ronning & Guldvog (1998b) (6)	✗	✗	✗	✗
Cabral et al. (2003) (5)	✗	✗	✗	

Conclusions

1. ***Acute stroke care, characterized by intensive monitoring and treatment for medical complications, is associated with reductions in combined death/disability and the need for institutionalization, but not reductions in mortality, length of hospital stay, or functional disability.***

Combined Acute and Rehabilitation Units

Combined Stroke Unit Care Compared to General Medical Ward Care

Study (PEDro Score)	Mortality 	Dependency 	Length of Stay 	Institutionalization 
Garraway et al. (1980) (5)	✗	✓	✓*	
Sivenius et al. (1985) (6)	✗	✓	✗	
Indredavik et al. (1991) (7)	✓ (6 weeks)	✓	✓	✓
	✗ (52 weeks)	✓		✓
Indredavik et al. (1997) (7)	✓	✓		✗
Indredavik et al. (1999a) (7)	✓	✓		✗
Kaste et al. (1995a) (8)	✗	✓	✓	
Fagerberg et al. (2000) (8)	✗	✗	✗	✗
Ma et al. (2004b) (5)		✓		
Chan et al. (2014) (9)		✗	✗	

**** No test of statistical significance was performed***

Conclusions

1. ***Interdisciplinary combined acute and rehabilitation stroke units reduce combined death/dependency, need for institutionalization, and length of hospital stay, but not overall mortality, when compared to general medical wards.***

Key Studies Combined Acute and Rehabilitation Unit

- Garraway WM, Akhar AJ, Prescott RJ, Hockey L. Management of acute stroke in the elderly: preliminary results of a controlled trial. BMJ 1980; 280:1040-1043.
- Indredavik B, Bakke F, Solberg R, Rokseth R, Haaheim LL, Holme I. Benefit of a stroke unit: a randomized controlled trial. Stroke 1991; 22:1026-1031.
- Indredavik B, Slordahl SA, Bakke F, Rokseth R, Haheim LL. Stroke unit treatment. Long-term effects. Stroke 1997; 28:1861-1866.
- Indredavik B, Bakke F, Slordahl SA, Rokseth R, Haheim LL. Treatment in a combined acute and rehabilitation stroke unit: which aspects are most important? *Stroke 1999b;30:917-23.*

Brain Reorganization, Recovery and Organized Care

- Indredavik B, Slordahl SA, Bakke F, Rokseth R, Haheim LL. Stroke unit care improves long-term survival and function. Cardiology Review 1999; 16:24-27(a).
- Fagerberg B, Claesson L, Gosman-Hedstrom G, Blomstrand C. Effect of acute stroke unit care integrated with care continuum versus conventional treatment: A randomized 1-year study of elderly patients: the Goteborg 70+ Stroke Study. *Stroke 2000;31:2578-84.*

Subacute Rehabilitation

Stroke Rehabilitation Units Compared to General Medical Ward

Study (PEDro Score)	Mortality 	Dependency 	Length of Stay 	Institutionalization 
Peacock et al. (1972) (5)		✗		
Stevens et al. (1984) (6)	✗	✓ (ADL: dressing) ✗ (ADL: all others)	✗	✗
Kalra et al. (1994a, 1994b, 1993) (5)	✓ (Severe)	✓ (Moderate)	✓ (Moderate/ Severe)	✓ (Moderate)
	✗	✗	✗	✗
Kalra & Eade (1995) (5)	✓	✗	✓	✗
Juby et al. (1996) (6) Drummond et al. (2005) (6)	✗	✓ (ADL at 3/6mo)	✗	✗
	✓ (at 10yr)	✗		
Yagura et al. (2005) (6)		✗	✗	✗ ✓ (Severe)

Conclusions

1. ***Interdisciplinary specialized subacute stroke rehabilitation is associated with reduced mortality and combined death/dependency, but not the need for institutionalization or length of hospital stay, when compared to general rehabilitation.***
2. ***Subgroups of patients will benefit from subacute rehabilitation in different ways: patients with more severe strokes experience reduced mortality; those with moderate strokes experience improved functional outcomes; and those with mild strokes do not improve to a greater extent compared with standard care.***

Key Studies for Subacute Rehabilitation

- Kalra L, Dale P, Crome P. Improving stroke rehabilitation. A controlled study. Stroke 1993; 24:1462-1467.
- Ronning OM, Guldvog B. Outcome of subacute stroke rehabilitation: a randomized controlled trial. Stroke 1998; 29:779-784.

Mobile Stroke Teams

Mobile Stroke Team Compared to Conventional Medical Management

Study (PEDro Score)	Mortality	Dependency	Length of Stay	Institutionalization
Hamrin (1982) (4)	✗	✗	✗	✗
Wood Dauphinee et al. (1984b) (6)	✓ (Males)	✓ (Males)		
	✗	✗		
Kalra et al. (2000, 2005) (8)	✗	✗		✗
Dey et al. (2005) (8)	✗	✗		✗

Conclusion

1. ***Discrete care elements associated with stroke units do not provide the same benefit when provided by a mobile stroke team.***

Meta-Analyses of Combined Results

Mortality

Pooled Analysis for Mortality

Model of Care	OR (95% CI)
Acute stroke care	0.80 (0.61, 1.03)
Combined acute and subacute stroke rehabilitation	0.88 (0.66, 1.16)
Subacute rehabilitation	0.60 (0.44, 0.81)
Mobile stroke team	1.13 (0.83, 1.55)
Overall	0.83 (0.71, 0.95)

Death or Dependency

Pooled Analysis for Death or Dependency

Model of Care	OR (95% CI)
Acute stroke care	0.70 (0.56, 0.86)
Combined acute and subacute stroke rehabilitation	0.56 (0.44, 0.71)
Subacute rehabilitation	0.63 (0.48,0.83)
Mobile stroke team	1.00 (0.73, 1.38)
Overall	0.680.60-0.77)

Conclusions

1. ***All models of care, except for mobile stroke teams, were associated with statistically significant reductions in the odds of death or dependency.***
2. ***The pooled result was similar to that obtained by the Stroke Unit Trialists' Collaboration (2013) for the same outcome (OR 0.79, 95% CI 0.68 to 0.90).***

Institutionalization

Pooled Analysis for Need for Institutionalization

Model of Care	Initial Analysis OR (95% CI)	Modified Analysis OR (95% CI)
Acute stroke care	0.53 (0.38, 0.74)	0.95 (0.60,1.52)
Combined acute and subacute stroke rehabilitation	0.53(0.31, 0.89)	0.53(0.31, 0.89)
Subacute rehabilitation	0.84 (0.62, 1.14)	0.84 (0.62, 1.14)
Mobile stroke team	1.23 (0.70, 2.17)	1.23 (0.70, 2.17)
Overall	0.70 (0.58, 0.85)	0.84 (0.68, 1.04)

Length of Stay

Pooled Analysis for Length of Stay

Model of Care	Weighted Mean Difference (95% CI) (Days)
Acute stroke care	-2.9 (-10.0, 4.3)
Combined acute and subacute stroke rehabilitation	-17.5 (-30, -4.5)
Subacute rehabilitation	-13.2 (-48.3, 21.9)
Mobile stroke team	13.55 (0.3, 26.8)
Overall	-7.04 (-13.21, -0.9)

Summary

Summary of Results: Effectiveness of Stroke Care

Model of Care	Mortality 	Dependency 	Length of Stay 	Institutionalization 
Acute	✗	✓	✓	✗
Combined	✗	✓	✓	✓
Subacute	✓	✓	✗	✗
Mobile	✗	✗	✗	✗
Overall	✓	✓	✓	✓

Conclusion

1. ***Specialized stroke care can improve multiple outcomes including mortality, dependency, need for institutionalization, and length of hospital stay.***

1b. Elements of Stroke Rehabilitation

Earlier Therapy is Better

Conclusion

1. ***Early mobilization may be beneficial for improving motor function and ambulation and mobility, but not stroke severity, length of stay or mortality.***
2. ***The evidence is mixed concerning activities of daily living.***

Key Studies for Earlier Therapy

- Biernaskie J, Chernenko G, Corbett D. Efficacy of rehabilitative experience declines with time after focal ischemic brain injury. J Neurosci 2004; 24(5):1245-1254.
- Paolucci S, Antonucci G, Grasso MG, Morelli D, Troisi E, Coiro P, Bragoni M. Early versus delayed inpatient stroke rehabilitation: A matched comparison conducted in Italy. Archives Phys Med Rehabil 2000; 81:695-700.
- Salter K, Jutai J, Hartley M, Foley N, Bhogal S, Bayona N, Teasell R. Impact of early vs delayed admission to rehabilitation on functional outcomes in persons with stroke. J Rehabil Med 2006; 38(2):113-117.
- Bai Y, Hu Y, Wu Y, Zhu Y, He Q, Jiang C, . . . Fan W. A prospective, randomized, single-blinded trial on the effect of early rehabilitation on daily activities and motor function of patients with hemorrhagic stroke. J Clin Neurosci (2012);19:1376-9.
- Bai YL, Hu YS, Wu Y, Zhu YL, Zhang B, Jiang CY, . . . Fan WK. Long-term three-stage rehabilitation intervention alleviates spasticity of the elbows, fingers, and plantar flexors and improves activities of daily living in ischemic stroke patients: a randomized, controlled trial. Neuroreport (2014);25:998-1005.
- Chippala P, Sharma R. Effect of very early mobilisation on functional status in patients with acute stroke: a single-blind, randomized controlled trail. Clinical Rehabilitation (2016);30:669-75
- Bernhardt J. Efficacy and safety of very early mobilisation within 24 h of stroke onset (AVERT): A randomised controlled trial. The Lancet (2015);386:46-55.
- Bernhardt, J., Churilov, L., Ellery, F., Collier, J., Chamberlain, J., Langhorne, P., ... & Donnan, G. (2016). Prespecified dose-response analysis for a very early rehabilitation trial (AVERT). Neurology, 86(23), 2138-2145.

Intensity of Physiotherapy and Occupational Therapy Post Stroke

Conclusions

1. ***Greater intensities of physiotherapy and occupational therapy appeared to result in improved functional outcomes.***
2. ***There are significant problems delivering an optimal dose of therapy intensities in actual clinical practice.***

Key Studies for Intensity of Physiotherapy and Occupational Therapy Post Stroke

- Kalra L. The influence of stroke unit rehabilitation on functional recovery from stroke. Stroke 1994; 25:821-825.
- Slade A, Tennant A, Chamberlain MA. A randomised controlled trial to determine the effect of intensity of therapy upon length of stay in a neurological rehabilitation setting. *J Rehabil Med (2002);34:260-6.*
- Glasgow Augmented Physiotherapy Study (GAPS) group. Can augmented physiotherapy input enhance recovery of mobility after stroke? A randomized controlled trial. *Clin Rehabil (2004);18:529-37.*

- Kwakkel G, Wagenaar RC, Twisk JW, Lankhorst GJ, Koetsier JC. Intensity of leg and arm training after primary middle-cerebral-artery stroke: a randomised trial. *Lancet (1999);354:191-6.*

Follow-up:

- Kwakkel G, van Peppen R, Wagenaar RC, et al. Effects of augmented exercise therapy time after stroke: a meta-analysis. Stroke 2004; 35:2529-2539.
- Kwakkel, G., Kollen, B. J., & Wagenaar, R. C. (2002). Long term effects of intensity of upper and lower limb training after stroke: a randomised trial. Journal of Neurology, Neurosurgery & Psychiatry, 72(4), 473-479.
- De Wit L, Putman K, Schuback B, Komárek A, Angst F, Baert I, Berman P, Bogaerts K, Brinkmann N, Connell L, Dejaeger E, Feys H, Jenni W, Kaske C, Lesaffre E, Leys M, Lincoln N, Louckx F, Schupp W, Smith B, De Weerdt W. Motor and functional recovery after stroke: a comparison of 4 European rehabilitation centers. Stroke 2007; 38(7):2101-2107.

Intensity of Aphasia Therapy Post Stroke

Conclusion

1. ***For patients who can tolerate it, more intensive speech and language therapy appears to result in improved outcomes.***

Key Studies for Intensity of Aphasia Therapy

- Bhogal SK, Teasell R, Speechley M. Intensity of aphasia therapy, impact on recovery. Stroke 2003; 34(4):987-993.
- Bakheit AM, Shaw S, Barrett L, Wood J, Carrington S, Griffiths S, . . . Koutsi F. A prospective, randomized, parallel group, controlled study of the effect of intensity of speech and language therapy on early recovery from poststroke aphasia. Clin Rehabil (2007);21:885-94.
- Godecke E, Hird K, Lalor EE, Rai T, Phillips MR. Very early poststroke aphasia therapy: a pilot randomized controlled efficacy trial. Int J Stroke (2012);7:635-44.

Weekend Therapy and Other Innovative Approaches to Increase Therapy Intensity

Conclusion

1. ***The evidence on weekend therapy providing better outcomes on 5 day per week therapy is mixed.***

Key Studies for Weekend Therapy

- Sonoda S, Saitoh E, Nagai S, Kawakita M, Kanada Y. Full-time integrated treatment program, a new system for stroke rehabilitation in Japan: comparison with conventional rehabilitation. Am J Phys Med Rehabil 2004; 83(2):88-93.
- English C, Bernhardt J, Crotty M, Esterman A, Segal L, Hillier S. Circuit class therapy or seven-day week therapy for increasing rehabilitation intensity of therapy after stroke (CIRCIT): a randomized controlled trial. International Journal of Stroke (2015);10:594-602.

Caregiver-Mediated Intensity of Therapy

Conclusions

1. ***There is strong evidence that additional caregiver-supported therapy results in improved functional outcomes compared to conventional therapy alone.***
2. ***Greater intensities of therapy with caregiver support may result in improved functional outcomes.***
3. ***More research is needed to strengthen the current evidence.***

Key Studies for Caregiver Mediated Intensity of Therapy

- Galvin R, Cusack T, O'Grady E, Murphy TB, Stokes E. Family-mediated exercise intervention (FAME): evaluation of a novel form of exercise delivery after stroke. Stroke (2011);42:681-6.
- Barzel A, Ketels G, Stark A, Tetzlaff B, Daubmann A, Wegscheider K, . . . Scherer M. Home-based constraint-induced movement therapy for patients with upper limb dysfunction after stroke (HOMECIMT): a cluster-randomised, controlled trial. Lancet Neurol (2015);14:893-902.
- Wang TC, Tsai AC, Wang JY, Lin YT, Lin KL, Chen JJ, . . . Lin TC. Caregiver-mediated intervention can improve physical functional recovery of patients with chronic stroke: A randomized controlled trial. Neurorehabilitation and Neural Repair (2015);29:3-12.

Task Specific Therapy

Conclusions

1. ***Task-specific therapy allows for the best recovery.***
2. ***NDT or the Bobath restorative approach results in longer lengths of stay and offers no advantage over other therapy approaches.***
3. ***Task-specific therapeutic approaches allow for the best recovery with improved FIM scores, improved discharge destination and shorter lengths of stay.***

Key Articles for Task-Specific Therapy

- Langhammer B, Stanghelle JK. Bobath or motor relearning programme? A comparison of two different approach of physiotherapy in stroke rehabilitation: a randomized controlled study. Clinical Rehabilitation 2000; 14:361-369.
- Langhammer B, Stanghelle JK. Bobath or Motor Relearning Programme? A follow-up one and four years post stroke. Clinical Rehabilitation 2003; 17:731-734
- Van Vliet PM, Lincoln NB, Foxall A. Comparison of Bobath based and movement science-based treatment for stroke: a randomized controlled trial. J Neurol Neurosurg Psychiatry (2005); 76:503-508.
- Hafsteindottir TB, Algra A, Kappelle LJ, Grypdonck MH. Neurodevelopmental treatment after stroke: a comparative study. J Neurology Neurosurg Psychiatry (2005); 76(6):788-792.

1c. Outpatient Therapy

Outpatient Stroke Rehab Therapy

Conclusion

1. ***The evidence is mixed as to whether home- nor clinic-based therapy appeared to improve outcomes during outpatient rehabilitation.***

Key Studies for Outpatient Stroke Rehab Therapy

- Chaiyawat P, Kulkantrakorn K. Randomized controlled trial of home rehabilitation for patients with ischemic. Psychogeriatrics (2012);12:193-9.
- Welin L, Bjalkefur K, Roland I. Open, randomized pilot study after first stroke: a 3.5-year follow-up. Stroke (2010);41:1555-7.
- Walker MF, Gladman JR, Lincoln NB, Siemonsma P, Whiteley T. Occupational therapy for stroke patients not admitted to hospital: a randomised. Lancet (1999);354:278-80.

Follow-up:

- Walker, M. F., Hawkins, K., Gladman, J. R. F., & Lincoln, N. B. (2001). Randomised controlled trial of occupational therapy at home: results at 1 year. Journal of Neurology, Neurosurgery & Psychiatry, 70(2), 267-267.

- Goldberg G, Segal ME, Berk SN, Schall RR, Gershkoff AM. Stroke transition after inpatient rehabilitation. Topics in Stroke Rehabilitation (1997); 4:64-79.

Hospital vs. Home-Based Outpatient Therapies

Conclusion

1. ***There appears to be no difference in efficacy between home or hospital-based therapy during outpatient rehabilitation.***

Key Studies for Hospital vs Home-Based Outpatient Therapies

- Gladman JR, Lincoln NB, Barer DH. A randomised controlled trial of domiciliary and hospital-based rehabilitation for stroke patients after discharge from hospital. J Neurol Neurosurg Psychiatry (1993); 56:960-966.

Follow-up:

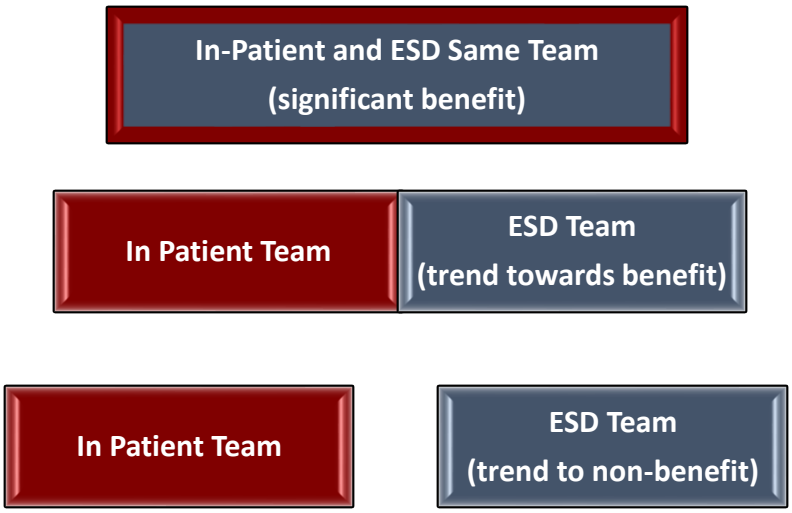
- Gladman, J. R. F., Lincoln, N. B., & DOMINO Study Group. (1994). Follow-up of a controlled trial of domiciliary stroke rehabilitation (DOMINO Study). Age and Ageing, 23(1), 9-13.
- Lincoln NB, Walker MF, Dixon A, Knights P. - Evaluation of a multi-professional community stroke team: a randomized controlled. Clin Rehabil (2004);18:40-7.
- Roderick P, Low J, Day R, Peasgood T, Mullee MA, Turnbull JC, . . . Raftery J. Stroke rehabilitation after hospital discharge: a randomized trial comparing. Age Ageing 2001 ;30:303-10.
- Young JB, Forster A. The Bradford community stroke trial: results at six months. BMJ 1992;304:1085-9.

Early Supported Discharge (ESD)

Outcome at End Of Scheduled Follow-Up (ESD Vs. Conventional Care) Stratified By Level Of Service Provision (More Coordinated To Less Coordinated) (Langhorne et al. 2017)

Death or dependency	Significant Result	Odds Ratio (OR) and 95% CI
Overall result	Yes	0.80 (0.67 to 0.95)
ESD team with coordination and delivery	Yes	0.67 (0.52 to 0.87)
ESD team coordination	Yes	0.82 (0.61 to 1.10)
no ESD team coordination	No	1.11 (0.75 to 1.62)

Visual picture of above Table showing the three types of ESD formats and benefits.



Conclusions

1. ***Early supported discharge may not be efficacious compared to conventional care for outpatient stroke rehabilitation.***
2. ***Early supported discharge with home therapy may not be more beneficial than early supported discharge with day clinic therapy for ambulation or balance.***

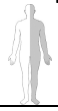
Key Studies for Early Supported Discharge

- Mayo NE, Wood-Dauphinee S, Cote R, Gayton D, Carlton J, Buttery J, Tamblyn R. There's no place like home: an evaluation of early supported discharge for stroke. Stroke 2000; 31:1016-1023.
- Teng J, Mayo NE, Latimer E, Hanley J, Wood-Dauphinee S, Cote R, Scott S. Costs and caregiver consequences of early supported discharge for stroke patients. Stroke. 2000; 34(2):528-36.

2. Lower Extremity Motor and Mobility Rehabilitation

(Evidence Reviews Chapter 9 and Clinician's Handbook Chapter 3)

Lower Extremity Assessment and Outcome Measures

Category	Rationale	Individual Assessment Tools
Motor Function 	These outcome measures covered gross motor movements and a series of general impairment measures when using the lower extremities	• Brunnstrom Recovery Stages • Chedoke McMaster Stroke Assessment Scale • Fugl-Meyer Assessment • Rivermead Motor Assessment
Activities of Daily Living 	These outcome measures assessed performance and level of independence in various everyday tasks.	• Barthel Index and Modified Barthel Index • Frenchay Activities Index • Functional Independence Measure • Motor Assessment Scale • Stroke Impact Scale
Spasticity 	These outcome measures assessed changes in muscle tone, stiffness, and contractures.	• Modified Ashworth Scale • Modified Tardieu Scale
Range of Motion 	These outcome measures assessed a patient's ability to freely move their lower extremity through flexion, abduction, and subluxation movements for instance, both passively and actively.	• Active ROM • Passive ROM
Proprioception 	These outcome measures assessed sensory awareness about one's body and the location of limbs.	• Joint Position Sense Test • Revised Nottingham Sensory Assessment
Global Stroke Severity 	These outcome measures assessed the severity of one's stroke through a global assessment of a multitude of deficits a stroke survivor may experience.	• Modified Rankin Scale • National Institutes of Health Stroke Scale • Scandinavian Stroke Scale
Muscle Strength 	These outcome measures assessed muscle power and strength during movements and tasks.	• Hand Grip Strength • Isokinetic Peak Torque • Manual Muscle Strength Test • Medical Research Council Scale
Functional Ambulation 	These outcomes measures assessed ambulatory abilities during distance-based or timed walking exercises commonly.	• 10-Metre Walk Test • 2-Minute Walk Test • 30-Second Sit-to-Stand Test • 6-Minute Walk Test • Functional Ambulation Category • Gait Distance • Gait Speed
Balance	These outcome measures assessed postural stability,	• Berg Balance Scale • Community Balance and Mobility Scale • Rate of Falls

	and both static and dynamic balance.	• Sitting Balance • Sit-to-Stand Test • Timed Up & Go Test
Functional Mobility 	These outcome measures assessed a person's ability to move around their environment, from one position or place to another, to complete everyday activities or tasks.	• Clinical Outcome Variable Scale • Functional Independence Measure • Rivermead Mobility Index
Gait 	These outcome measures assessed various phases of the gait cycle.	• Functional Gait Assessment • Gait Assessment and Intervention Tool • Gait Cycle Time • Step Length, Step Reaction Time and Step Test • Stride Length and Stride Width

Therapy Intensity

Conclusions

1. ***Overall, there is strong evidence that early intensive therapy may improve gait and general motor function.***
2. ***There is conflicting high-quality evidence regarding the effect of augmented physical therapy on gait at follow-up.***

Task-Specific Training

Intervention	**ADLs** 	**Functional Ambulation** 	**Balance** 	**Functional Mobility** 
Bobath Concept Approach	**1a** **3 RCTs** 	**1b** **1 RCT** 	**1b** **1 RCT**	**1a** **2 RCTs**
Motor Relearning Programmes	**1b** **1 RCT** 	**1b** **2 RCTs** 	**1a** **3 RCTs** 	

Conclusions

1. ***Task-specific training of the lower limbs may improve functional ambulation, balance and ADLs post stroke.***
2. ***Further research is required to determine the efficacy of task-specific circuit training.***
3. ***The Neurodevelopmental Approach may improve ADLs when compared to conventional care.***

Key Studies for Task-Specific Training

- Van de Port IGL, Wevers LEG, Lindeman E, Kwakkel G. Effects of circuit training as alternative to usual physiotherapy after stroke: A randomised controlled trial. BMJ 2012; 344: e2072.
- Dean et al. (2012). Exercise to enhance mobility and prevent falls after stroke: the community stroke club randomized trial. Neurorehabil Neural Repair 2012; 26(9):1046-1057.

Lower Extremity Motor and Mobility Rehabilitation

- Salbach NM, Mayo NE, Wood-Daphinee S, Hanley JA, Richard CL. A task-oriented intervention enhances walking distance and speed in the first year post stroke. A randomized controlled trial. Clinical Rehabilitation 2004; 18:509-519.

Overground Walking

Intervention	Functional Ambulation	Balance	Gait
Overground Walking	1a 6 RCTs ✓	1a 4 RCTs ✗	1a 2 RCTs ✓

Conclusion

1. ***Overground walking may be beneficial for improving functional ambulation and gait but not balance.***

Key Studies for Overground Walking

- Gordon CD, Wilks R, McCaw-Binns A. Effect of aerobic exercise (walking) training on functional status and health-related quality of life in chronic stroke survivors: a randomized controlled trial. Stroke 2013; 44(4):1179-1181.
- Sandberg K, Kleist M, Falk L, Enthoven P. Effects of twice-weekly intense aerobic exercise in early subacute stroke: a randomized controlled trial. Arch Phys Med Rehabil 2016; 97(8):1244-1253.

Exercise Bicycle

Intervention	Motor Function	ADLs	Spasticity	Muscle Strength	Functional Ambulation	Balance	Functional Mobility	Gait
Cycle Ergometer	2 1 RCT ✓	1b 3 RCTs ✓	2 1 RCT ✗	1b 2 RCTs ✗	1a 6 RCTs ↻	1b 1 RCT ✓	2 1 RCT ✗	1b 2 RCTs ✗

Conclusions

1. ***Cycle ergometer training may be beneficial for improving motor function, balance and ADLs, but not beneficial for functional mobility, gait, spasticity and muscle strength.***
2. ***The evidence is mixed for cycle ergometer training improving functional ambulation.***

Key Studies for Exercise Bike

- Jin H, Jiang Y, Wei Q, Wang B, Ma, G. Intensive aerobic cycling training with lower limb weights in Chinese patients with chronic stroke: discordance between improved cardiovascular fitness and walking ability. Disabil Rehabil 2012; 34(19):1665-1671.
- Mayo NE, MacKay-Lyons MJ, Scott SC, Moriello C, Brophy J. A randomized trial of two home-based exercise programmes to improve functional walking post-stroke. Clin Rehabil 2013; 27(7):659-671.

Treadmill Training in the Absence of Partial Body Weight Support

Intervention	Motor Function	ADLs	Functional Ambulation	Balance	Functional Mobility	Gait
Treadmill Training	1b 1 RCT ✗	1b 2 RCTs ✗	1a 7 RCTs ✓	1a 5 RCTs ✗	1b 2 RCTs ↻	1a 6 RCTs ↻

Conclusions

1. ***Treadmill training may improve functional ambulation, but may not impact balance, ADLs and motor function.***
2. ***The evidence is mixed for functional ambulation and gait.***

Key Studies for Treadmill Training

- Pohl M, Mehrholz J, Ritschel C, Ruckriem S. Speed-dependent treadmill training in ambulatory hemiparetic stroke patients. A randomized controlled trial. Stroke 2002; 33:553-558.
- Richards CL, Malouin F, Bravo G, Dumas F, Wood-Dauphinee S. The role of technology in task-oriented training in persons with subacute stroke: a randomized controlled trial. Neurorehabil and Neural Repair, 2004; 18(4):199-211.
- Macko RF, Ivey FM, Forrester LW, Hanley D, Sorkin JD, Katzel LI et al. Treadmill exercise rehabilitation improves ambulatory function and cardiovascular fitness in patients with chronic stroke: a randomized, controlled trial. Stroke 2005; 36(10):2206-2211.
- Park IM, Lee YS, Moon BM, Sim SM. A comparison of the effects of overground gait training and treadmill gait training according to stroke patients' gait velocity. J Phys Ther Sci 2013; 25(4):379-382.

Partial Body Weight Support and Treadmill Training (PBWSTT)

Intervention	Motor Function	ADLs	Stroke Severity	Muscle Strength	Functional Ambulation	Balance	Functional Mobility	Gait
Partial Body Weight Support Treadmill Training	1b 1 RCT ✓	1b 4 RCTs ✗	1b 2 RCTs ✗	1b 1 RCT ✓	1b 3 RCTs ↻	1a 9 RCTs ✗	2 1 RCT ✓	1a 6 RCTs ↻

Conclusions

1. ***Based on all RCTs, partial-body weight support treadmill training does not appear to improve ADLs, stroke severity with a mixed picture for gait and functional ambulation.***
2. ***There is strong evidence that partial body weight support treadmill training may not improve gait or balance outcomes compared to conventional or other gait training interventions based on the most definitive trial, the LEAPs trial (Duncan et al. 2011).***

Lower Extremity Motor and Mobility Rehabilitation

Key Studies for Partial Body Weight Support and Treadmill Training

- Visintin M, Barbeau H, Korner-Bitensky N, Mayo NE. A new approach to retrain gait in stroke patients through body weight support and treadmill stimulation. Stroke 1998; 29:1122-1128.
- Ada L, Dean CM, Morris ME, Simpson JM, Katrak P. Randomized Trial of Treadmill Walking With Body Weight Support to Establish Walking in Subacute Stroke. The MOBILISE Trial. Stroke 2010; 41:1237-1242.
- LEAPS (Locomotor Experience Applied Post-Stroke) trial – Duncan PW, Sullivan KJ, Behrman AL et al. K Body-weight-supported treadmill rehabilitation after stroke. NEJM 2011; 364:2026-36.
- MacKay-Lyons M, McDonald A, Matheson J, Eskes G, Klus MA. Dual effects of body weight supported treadmill training on cardiovascular fitness and walking ability early after stroke: a randomized controlled trial. Neurorehabil and Neural Repair 2013; 27(7):644-653.
- DePaul VG, Wishart LR, Richardson J, Thabane L, Ma J, Lee TD. Varied overground walking training versus body-weight-supported treadmill training in adults within 1 year of stroke: a randomized controlled trial. Neurorehabil and Neural Repair 2015; 29(4):329-340.

Physiotherapy Exercise Programs and Aerobic Training

Intervention	Motor Function	ADLs	Spasticity	Muscle Strength	Functional Ambulation	Balance	Functional Mobility	Gait
Overground Walking					1a 6 RCTs ✓	1a 4 RCTs ✗		1a 2 RCTs ✓
Cycle Ergometer	2 1 RCT ✓	1b 3 RCTs ✓	2 1 RCT ✗	1b 2 RCTs ✗	1a 6 RCTs ⟳	1b 1 RCT ✓	2 1 RCT ✗	1b 2 RCTs ✗
Treadmill Training	1b 1 RCT ✗	1b 1 RCT ✗			1a 7 RCTs ✓	1a 5 RCTs ✗	1b 2 RCTs ⟳	1a 6 RCTs ⟳

Conclusion

1. ***Overground walking appears to improve functional ambulation and gait but not balance.***
2. ***Cycle ergometer training may be beneficial for improving motor function, balance and ADLs, but not beneficial for functional mobility, gait, spasticity and muscle strength. The evidence is mixed for cycle ergometer training improving functional ambulation.***
3. ***Treadmill training may improve functional ambulation, but may not impact balance, ADLs and motor function. The evidence is mixed for functional ambulation and gait.***

Key Articles for Physiotherapy Exercise Programs

- Duncan P, Studenski S, Richards L, et al. Randomized clinical trial of therapeutic exercise in subacute stroke. Stroke 2003; 34:2173-2180.
- Gordon CD, Wilks R, McCaw-Binns, A. Effect of Aerobic Exercise (Walking) Training on Functional Status and Health-related Quality of Life in Chronic Stroke Survivors A Randomized Controlled Trial. Stroke 2013; 44(4), 1179-1181.

Lower Extremity Motor and Mobility Rehabilitation

- Brazzelli M, Saunders DH, Greig CA, Mead GE. Physical fitness training for stroke patients. Cochrane Database of Systematic Reviews 2011, Issue 11. Art. No.: CD003316. DOI:10.1002/ 14651858. CD003316.pub4.

Strength Training to Improve Mobility

Intervention	ADLs	Muscle Strength	Functional Ambulation	Balance	Functional Mobility	Gait
Strength and Resistance Training	1b 2 RCTs	1a 6 RCTs	1a 7 RCTs	1a 9 RCTs	1a 4 RCTs	1a 7 RCTs

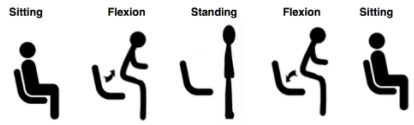
Conclusion

1. ***Due to conflicting findings, it is unclear whether strength and resistance training for the lower limbs improves ADLs, muscle strength, functional ambulation and gait.***
2. ***There was considerable heterogeneity in the type, duration, and intensity of strength/resistance interventions.***
3. ***There is strong evidence that strength and resistance training for the lower limbs improves balance but not functional mobility.***

Key Studies for Strength and Resistance Training

- Moreland JD, Goldsmith CH, Huijbregts MP, Anderson RE, Prentice DM, Brunton KB, O'Brien A, Torresin WD. Progressive resistance strengthening exercises after stroke: a single-blind randomized controlled trial. Arch Phys Med Rehabil 2003; 84:1433-40.
- Mead GE, Greig CA, Cunningham I et al. Stroke: a randomized trial of exercise or relaxation. J Am Geriatr Soc 2007; 55:892-899.
- Cooke EV, Tallis RC, Clark A, Pomeroy VM. Efficacy of functional strength training on restoration of lower-limb motor function early after stroke: phase I randomized controlled trial. Neurorehabilitation and Neural Repair 2010; 24(1):88-96.

Sit-to-Stand Training

Intervention	Muscle Strength	Balance	Gait
Sit to Stand Training 	1b 1 RCT	1b 1 RCT	1b 1 RCT

Conclusion

Lower Extremity Motor and Mobility Rehabilitation

1. ***Sit-to-stand training may be beneficial for improving gait and muscle strength, but not balance.***

Key Study for Sit to Stand Training

- Liu M, Chen J, Fan W, Mu J, Zhang J, Wang L., Zhuang J, Ni C. (2016). Effects of modified sit-to-stand training on balance control in hemiplegic stroke patients: a randomized controlled trial. Clin Rehabilitation 2016; 30(7):627-636.

Trunk Training

Intervention	Motor Function	ADLs	Stroke Severity	Muscle Strength	Functional Ambulation	Balance	Functional Mobility	Gait
Trunk Training	1a 4 RCTs ✓	2 2 RCTs ↻	2 1 RCT ✓	2 1 RCT ✓	2 1 RCT ✓	1a 5 RCTs ✓	2 1 RCT ✓	1b 2 RCTs ✓

Conclusion

1. ***Both trunk training and enhanced trunk training may be beneficial for most lower limb rehab outcomes, in particular balance and motor function where the evidence is strong.***

Key Study for Trunk Training

- Saeys W, Vereeck L, Truijen S, Lafosse C, Wuyts FP, Van de Heyning P. Randomized controlled trial of truncal exercises early after stroke to improve balance and mobility. Neurorehabil and Neural Repair 2012; 26(3):231-238.

Balance Training

Intervention	Motor Function	ADLs	Stroke Severity	Muscle Strength	Functional Ambulation	Balance	Gait
Balance Trainers	1b 3 RCTs ↻	1a 8 RCTs ↻	2 1 RCT ✗	1b 2 RCTs ✗	1b 3 RCTs ↻	1a 18 RCTs ↻	2 2 RCTs ✗

Conclusion

1. ***Balance training does not appear to improve stroke severity, muscle strength or gait. The evidence is mixed for improvements in balance, ADLs, motor function and functional ambulation.***

Key Studies on Balance Training

- Tang Q, Tan L, Li B, Huang X, Ouyang C, Zhan H, Pu Q, Wu L. Early sitting, standing, and walking in conjunction with contemporary Bobath approach for stroke patients with severe motor deficit. Topics in Stroke Rehabilitation 2014; 21(2):120-127.

Lower Extremity Motor and Mobility Rehabilitation

- Lee SH, Byun SD, Kim CH, Go JY, Nam HU, Huh JS, Jung TD. Feasibility and Effects of Newly Developed Balance Control Trainer for Mobility and Balance in Chronic Stroke Patients: A Randomized Controlled Trial. Annals of Rehabilitation Medicine 2012; 36(4):521-529.

Balance Training and Risk of Falling

Conclusion

1. ***Falls prevention programs may not reduce the rate of falls post stroke.***

Key Study for Balance Training and Risk of Falling

- Batchelor FA, Hill KD, Mackintosh SF, Said CM, Whitehead CH. Effects of a multifactorial falls prevention program for people with stroke returning home after rehabilitation: A randomized controlled trial. Arch Phys Med Rehabil 2012; 93(9):1548-1655.

Caregiver Mediated Programs

Intervention	ADLs	Balance	Functional Mobility
Caregiver Mediated Programs	1a 2 RCTs	1b 1 RCT	1b 1 RCT

Conclusion

1. ***Caregiver-mediated programs may improve lower limb functional mobility, balance and ADLs.***

Key Study on Caregiver Mediated Training Programs

- Wang TC, Tsai AC, Wang JY, Lin YT, Lin KL, Chen JJ, Lin BY, Lin TC. Caregiver-mediated intervention can improve physical functional recovery of patients with chronic stroke: a randomized controlled trial. Neurorehabil Neural Repair 2015; 29(1):3-12.

Electromechanical and Robotic Assisted Mobility Training

Intervention	Motor Function	ADLs	Spasticity	ROM	Proprioception	Stroke Severity	Muscle Strength	Functional Ambulation	Balance	Functional Mobility	Gait
End Effectors (Robotics)	1a 3 RCTs	1a 6 RCTs	1b 1 RCT				1a 3 RCTs	1a 8 RCTs	1a 3 RCTs	1a 6 RCTs	
Exoskeleton (Robotics)	1a 8 RCTs	1a 6 RCTs	2 2 RCTs	2 1 RCT	1b 1 RCT	1b 1 RCT	1b 4 RCTs	1a 17 RCTs	1b 13 RCTs	1a 6 RCTs	1a 3 RCTs

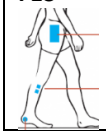
Conclusions

1. ***End effector robotics, using body weight support and moving foot plates, has been shown to improve functional ambulation and functional mobility and may help with motor function, ADLs, muscle strength and balance.***
2. ***The Lokomat, or a similar exoskeletal system (e.g. LokoHelp, AutoAmbulator, Walkbot), may improve motor function, muscle strength, functional ambulation, balance and gait; it does not improve ADLs and functional mobility.***
3. ***Specifically, Lokomat training may be beneficial for lower limb rehabilitation following stroke while evidence is more mixed for exoskeleton devices being effective for lower limb rehabilitation following stroke.***

Key Studies for Gait Robotics

- Mehrholz J, Werner C, Kugler J, Pohl M. Electromechanical-assisted training for walking after stroke. Cochrane Database of Systematic Reviews 2007, Issue 4. Art. No.: CD006185. DOI: 10.1002/ 14651858.CD006185.pub2.
- Pohl M, Werner C, Holzgraefe M, Kroczek G, Mehrholz J, Wingendorf J et al. Repetitive locomotor training and physiotherapy improve walking and basic activities of daily living after stroke: a single-blind, randomized multicentre trial (DeutscheGAngtrainerStudie, DEGAS). Clin Rehabil. 2007; 21(1):17-27.
- Schwartz I, Sajin A, Fisher I, Neeb M, Shochina M, Katz-Leurer M, Meiner Z. The effectiveness of locomotor therapy using robotic-assisted gait training in subacute stroke patients: a randomized controlled trial. PMR 2009; 1:516-523.
- Morone G, Bragoni M, Iosa M, De Angelis D, Venturiero V, Coiro P, Pratesi L, Paolucci S. Who may benefit from robotic-assisted gait training? A randomized clinical trial in patients with subacute stroke. Neurorehabil Neural Repair 2011; *25*:*636–644*.
- Morone G, Iosa M, Bragoni M, De Angelis D, Venturiero V, Coiro P, Riso R, Pratesi L, Paolucci S. Who may have durable benefit from robotic gait training: a 2-year follow-up randomized controlled trial in patients with subacute stroke? Stroke 2012; 43(4):1140-1142.
- Han EY, Im SH, Kim BR, Seo MJ, Kim MO. Robot-assisted gait training improves brachial–ankle pulse wave velocity and peak aerobic capacity in subacute stroke patients with totally dependent ambulation: Randomized controlled trial. Medicine 2016; 95(41).

Functional Electrical Stimulation/FES-Based Neural Orthosis for Gait Cycle

Intervention	Motor Function	ADLs	Spasticity	ROM	Muscle Strength	Functional Ambulation	Balance	Functional Mobility	Gait
FES 	1a 7 RCTs ↻	1a 6 RCTs ✓	1a 4 RCTs ↻	1b 1 RCT ✓	1a 4 RCTs ✓	1a 12 RCTs ✓	1a 5 RCTs ✗	1a 2 RCTs ✗	1a 7 RCTs ✓

Conclusions

1. ***Functional electrical stimulation may be a suitable adjunct for therapies targeting lower limb motor function post stroke.***
2. ***FES has been shown to improve ADLs, muscle strength, functional ambulation and gait. It may help motor function and spasticity but does not improve balance and functional mobility more than conventional care.***

Key Studies for Functional Electrical Stimulation

- Daly JJ, Zimbelman J, Roenigk KL, McCabe JP, Rogers JM, Butler K et al. Recovery of coordinated gait: Randomized controlled stroke trial of Functional Electrical Stimulation (FES) versus no FES, with weight-supported treadmill and over-ground training. Neurorehabil Neural Repair 2011; 25(7):588-596.
- Sheffler LR, Bailey S., Wilson RD, Chae J. Spatiotemporal, kinematic, and kinetic effects of a peroneal nerve stimulator versus an ankle foot orthosis in hemiparetic gait. Neurorehabil Neural Repair 2013; 27(5):403-410.
- Kluding PM, Dunning K, O'Dell MW et al. Foot drop stimulation versus ankle foot orthosis after stroke: 30-week outcomes. Stroke 2013; 44(6):1660-1669.
- Bethoux F, Rogers H, Nolan K et al. The effects of peroneal nerve functional electrical stimulation versus ankle-foot orthosis in patients with chronic stroke: A randomized controlled trial. Neurorehabilitation and Neural Repair 2014; 28(7): 688-697.
- Sheffler LR, Taylor PN, Bailey SN et al. Surface peroneal nerve stimulation in lower limb hemiparesis: effect on quantitative gait parameters. Am J Phys Med Rehabil 2015; 94(5):341.

Neuromuscular Electrical Stimulation

Intervention	Motor Function	ADLs	Spasticity	ROM	Stroke Severity	Muscle Strength	Functional Ambulation	Balance	Functional Mobility	Gait
NMES	1b 1 RCT ✗	1b 2 RCTs ↻	1a 6 RCTs ↻	1a 2 RCTs ↻	1a 2 RCTs ↻	1b 1 RCT ✓	1a 5 RCTs ↻	1a 18 RCTs ↻	2 1 RCT ✓	1b 1 RCT ✗

Conclusions

1. ***NMES may be beneficial for functional mobility and muscle strength.***
2. ***The literature is mixed for NMES regarding its improvement to functional ambulation, balance, spasticity, range of motion, stroke severity and activities of daily living.***
3. ***NMES may not be beneficial for improving motor function or gait.***
4. ***There was considerable heterogeneity in the delivery and type of NMES used.***

Biofeedback

Gait Training with Movement or Postural Control Visual Biofeedback

Intervention	Motor Function	Functional Ambulation	Balance	Functional Mobility	Gait
Gait Training with Movement or Postural Control Visual Biofeedback	1b 1 RCT ✗	1a 3 RCTs ✗	1a 3 RCTs ✗	2 1 RCT ✗	1a 8 RCTs ✗

Conclusion

1. ***Gait training with movement or postural visual feedback is likely not beneficial for lower limb rehab post stroke.***

Key Studies for Gait Training with Movement or Postural Control Visual Feedback

Lower Extremity Motor and Mobility Rehabilitation

- Drużbicki M, Guzik A, Przysada G, Kwolek A, Brzozowska-Magoń A. Efficacy of gait training using a treadmill with and without visual biofeedback in patients after stroke: a randomized study. J Rehabil Med 2015; 47(5)P:419-425.
- Dobkin et al. International randomized clinical trial, stroke inpatient rehabilitation with reinforcement of walking speed (SIRROWS) improves outcomes. Neurorehabili Neural Repair 2010; 24(3):235-242.
- Dorsch et al. SIRRACT: An international randomized clinical trial of activity feedback during inpatient stroke rehabilitation enabled by wireless sensing. Neurorehabil Neural Repair 2015; 29(5):407-415.

EMG Biofeedback

Intervention	Motor Function	ADLs	ROM	Muscle Strength	Functional Ambulation	Functional Mobility	Gait
EMG Biofeedback	2 1 RCT ✓	1b 1 RCT ✗	1b 2 RCTs ✗	1b 1 RCT ✓	2 1 RCT ✓	2 1 RCT ✗	1a 4 RCTs ↻

Conclusions

1. ***EMG biofeedback may produce improvements in motor function, muscle strength and functional ambulation, but not ADLs, ROM or functional mobility.***
2. ***The evidence is mixed regarding gait.***

Key Study for EMG Biofeedback

- Xu H, Jie J, Hailiang Z, Ma C. Effect of EMG-triggered stimulation combined with comprehensive rehabilitation training on muscle tension in poststroke hemiparetic patients. J Sport Med Phys Fit 2015; 55(11):1343-1347.

Rhythmic Auditory Stimulation

Intervention	ROM	Muscle Strength	Functional Ambulation	Balance	Gait
Rhythmic Auditory Stimulation	2 1 RCT ✓	1b 2 RCTs ✓	1a 8 RCTs ✓	1a 4 RCTs ✓	1a 10 RCTs ✓

Conclusions

1. ***Rhythmic auditory stimulation with physical exercise, including over ground gait training or treadmill training, is likely beneficial for lower limb rehabilitation following stroke.***
2. ***Rhythmic auditory stimulation training may improve gait, functional ambulation and balance post stroke.***

Key Studies for Rhythmic Auditory Stimulation for Gait Training

Lower Extremity Motor and Mobility Rehabilitation

- Thaut MH, Leins AK, Rice RR et al. Rhythmic auditory stimulation improves gait more than NDT/Bobath training in near-ambulatory patients early poststroke: A single-blind, randomized trial. Neurorehabil and Neural Repair 2007; 21(5):455-459.
- Suh JH, Han SJ, Jeon SY et al. Effect of rhythmic auditory stimulation on gait and balance in hemiplegic stroke patients. NeuroRehabilitation 2014; 34(1):193-199.

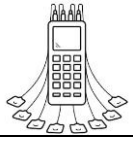
Dual Task Training

Intervention	Motor Function	ADLs	Functional Ambulation	Balance	Gait
Dual -Task Training 	2 1 RCT ✗	2 1 RCT ✗	1b 2 RCTs ↻	1b 2 RCTs ↻	1a 4 RCTs ↻

Conclusions

1. ***The literature is mixed concerning dual-task training's ability to improve functional ambulation, balance and gait.***
2. ***Dual-task training may not be beneficial for improving motor function and activities of daily living.***

Transcutaneous Electrical Nerve Stimulation

Intervention	Motor Function	ADLs	Spasticity	ROM	Muscle Strength	Functional Ambulation	Balance	Functional Mobility	Gait
TENS 	1a 2 RCTs ↻	1a 3 RCTs ✗	1a 7 RCTs ✓	1a 2 RCTs ✓	1a 4 RCTs ↻	1a 6 RCTs ✓	1a 4 RCTs ✓	1a 3 RCTs ✓	1a 2 RCTs ✓

Conclusions

1. ***TENS may be beneficial for improving functional mobility, functional ambulation, range of motion and spasticity.***
2. ***The literature is mixed regarding TENS for improving motor function, activities of daily living, gait, balance, and muscle strength.***

Lower Extremity Motor and Mobility Rehabilitation

Aquatic Therapy

Intervention	ADLs	Proprioceptttion	Spasticity	Muscle Strength	Functional Ambulation	Balance	Functional Mobility	Gait
Aquatic Therapy	1a 3 RCTs ✓	2 1 RCT ✓	1b 1 RCT ✗	1a 3 RCTs ✓	1a 8 RCTs ✓	1a 9 RCTs ⟳	1b 1 RCT ✗	1b 2 RCTs ⟳

Conclusions

1. ***Aquatic therapy may be beneficial for improving functional ambulation, activities of daily living, muscle strength, and proprioception.***
2. ***The literature is mixed regarding aquatic therapy for improving gait and balance.***
3. ***Aquatic therapy may not be beneficial for improving mobility or spasticity although the data is limited.***

Brain Stimulation

Repetitive Transcranial Magnetic Stimulation

Intervention	Motor Function	ADLs	Spasticity	ROM	Stroke Severity	Muscle Strength	Functional Ambulation	Balance	Gait
Low Frequency rTMS	1a 6 RCTs ⟳	1a 4 RCTs ✓	2 1 RCT ✓	1b 1 RCT ✓	1a 2 RCT ✓	1b 1 RCT ✓	1a 3 RCTs ✓	1a 3 RCTs ✓	1a 2 RCTs ✓
High Frequency rTMS	1a 3 RCTs ⟳	1a 4 RCTs ✓			1a 4 RCTs ✓	1b 1 RCT ✓	1a 3 RCTs ⟳	1b 1 RCT ✓	

Conclusions

1. ***Repetitive transcranial magnetic stimulation may be an effective intervention improving gait, balance, spasticity, range of motion, activities of daily living, muscle strength and stroke severity.***
2. ***The literature is mixed regarding the effect of rTMS on motor function and functional ambulation.***
3. ***The levels of evidence for low and high frequency rTMS are shown in the colour coded table above.***

Key Studies for rTMS

- Du J, Tian L, Liu W, Hu J, Xu G, Ma M, Fan X, Ye R, Jiang Y, Yin Q, Zhu W, Xiong Y, Yang F, Liu X. Effects of repetitive transcranial magnetic stimulation on motor recovery and motor cortex excitability in patients with stroke: a randomized controlled trial. Eur J Neurol 2016; 23(11):1666-1672.

Transcranial Direct Current Stimulation (tDCS)

Intervention	Motor Function	Muscle Strength	Functional Ambulation	Balance	Functional Mobility	Gait
Anodal tDCS	1b 1 RCT ✓	1a 2 RCTs ✓	1a 2 RCTs ⟳	1a 2 RCTs ⟳		1b 1 RCT ✗
Dual tDCS		1b 1 RCT ✗		1a 3 RCTs ⟳	1b 1 RCT ✗	1b 1 RCT ✗

Conclusions

1. ***The literature is mixed concerning the benefit of tDCS on lower extremity motor outcomes.***
2. ***Anodal tDCS improves muscle strength and may improve motor function, functional ambulation and balance.***
3. ***Dual tDCS may improve balance.***

Key Studies for tDCS

- Andrade SM, Batista LM, Nogueira LL, et al. Constraint-induced movement therapy combined with transcranial direct current stimulation over premotor cortex improves motor function in severe stroke: a pilot randomized controlled trial. Rehabilitation Research and Practice 2017.
- Saeys W, Vereeck L, Lafosse C, Truijen S, Wuyts FL, Van De Heyning P. Transcranial direct current stimulation in the recovery of postural control after stroke: a pilot study. Disabil Rehabil 2015; 37(20):1857-1863.

Virtual Reality and Gait/Balance

Intervention	Motor Function	ADLs	Spasticity	ROM	Proprioception	Stroke Severity	Muscle Strength	Functional Ambulation	Balance	Functional Mobility	Gait
Virtual Reality	1a 5 RCTs ⟳	1a 10 RCTs ⟳	2 1 RCT ✗		2 1 RCT ✓	1a 2 RCTs ✗	2 1 RCT ✗	1a 9 RCTs ⟳	1a 17 RCTs ⟳	1b 2 RCTs ⟳	1a 6 RCTs ✓
VR with Treadmill	2 1 RCT ✗			2 1 RCT ✓				1a 3 RCTs ✓	1a 9 RCTs ✓	2 1 RCT ✗	1a 7 RCTs ✓

Conclusions

1. ***Virtual reality training has been shown to improve gait and may improve motor function, ADLs, functional ambulation, balance and functional mobility.***
2. ***Virtual reality with treadmill training has been shown to improve gait, balance and functional ambulation.***

Action Observation

Intervention	Functional Ambulation	Balance	Gait
Action Observation	2 2 RCTs ✓	1b 2 RCTs ✓	1b 3 RCTs ✓

Conclusions

1. ***Action Observation has been shown to improve gait and balance and may improve functional ambulation.***

Motor Imagery/Mental Practice

Conclusions

Intervention	Motor Function	ADLs	Muscle Strength	Functional Ambulation	Balance	Functional Mobility	Gait
Mental Practice	1b 2 RCTs ↻	1b 2 RCTs ✗	1b 1 RCT ↻	1a 3 RCTs ↻	1b 4 RCTs ↻	1b 1 RCT ✗	1b 1 RCT ✓

1. ***Mental practice/motor imagery in combination with gait/balance training, may improve gait, balance, functional ambulation and motor function.***
2. ***Mental practice may not be beneficial for improving functional mobility and activities of daily living.***

Key Studies for Mental Practice

- Kumar VK, Chakrapani M, Kedambadi R. Motor imagery training on muscle strength and gait performance in ambulant stroke subjects-a randomized clinical trial. JCDR 2016; 10(3):YC01.

Assistive Walking Devices: Canes

Conclusions

1. ***Single-point canes improve gait speed and endurance, while quad canes improve balance.***

Ankle Foot Orthoses

Intervention	Functional Ambulation	Balance	Gait
AFO	1a 4 RCTs ✓	2 4 RCTs ⟳	1b 3 RCTs ✓

Conclusions

1. ***Ankle foot orthoses may be effective for improving gait and functional ambulation, but the evidence is mixed for balance.***

Key Studies for AFOs

- Wang R, Lin P, Lee C, Yang Y. Gait and balance performance improvements attributable to ankle-foot orthosis in subjects with hemiparesis. American J Phys Med Rehab 2007; 86(7):556-562.
- Pomeroy VM, Rowe P, Clark A et al. A Randomized controlled evaluation of the efficacy of an Ankle-Foot Cast on walking recovery early after Stroke: SWIFT Cast Trial. Neurorehabil Neural Repair 2016; 30(1):40-48.

Pharmaceuticals

Amphetamines

Intervention	Motor Function	ADLs	Stroke Severity	Functional Ambulation	Functional Mobility
Amphetamines	1a 8 RCTs ✗	1a 6 RCTs ✗	1a 3 RCTs ✗	1b 1 RCT ✗	1b 1 RCT ✗

Conclusions

1. ***Amphetamines do not improve lower limb motor function or ADLs post stroke.***

Key Studies for Amphetamines

- Gladstone DJ, Danells CJ, Armesto Y et al. Physiotherapy coupled with Dextroamphetamine for rehabilitation after hemiparetic stroke: A randomized, double-blind, placebo-controlled trial. Stroke 2006; 37(1):179-185.

Methylphenidate

Intervention	Motor Function	ADLs	Stroke Severity
Methylphenidate	1a 2 RCTs ✗	1a 2 RCTs ✓	1b 1 RCT ✓

Conclusions

1. ***Methylphenidate can improve functional independence but not lower limb motor function post stroke.***

Key Studies for Methylphenidate

- Lokk J, Roghani RS, Delbari A et al. Effect of methylphenidate and/or levodopa coupled with physiotherapy on functional and motor recovery after stroke: A randomized, double-blind, placebo-controlled trial. Acta Neurologica Scandinavica 2011; 123(4):266-273.

Levodopa

Intervention	Motor Function	ADLs	Stroke Severity
Levadopa	1a 2 RCTs ✓	1a 3 RCTs ⟳	1b 1 RCT ✓

Conclusions

1. ***Levodopa has been shown to improve lower limb motor function and may improve ADLs.***

Serotonergic Agents

Intervention	Motor Function	ADLs	Stroke Severity
Fluoxetine	1a 2 RCTs ✓	1a 4 RCTs ⟳	1a 3 RCTs ✗

Conclusions

1. ***Fluoxetine has been shown to improve lower limb motor function post stroke, it may improve functional independence but does not change stroke severity outcomes measures.***

Key Studies for Serotonergic Agents

- Chollet F, Tardy J, Albucher JF, Thalamas C, Berard E, Lamy C, Bejot Y, Deltour S, Jaillard A, & Niclot P. Fluoxetine for motor recovery after acute ischaemic stroke (FLAME): a randomised placebo-controlled trial. The Lancet Neurology 2011; 10(2):123-130.

Spasticity Post Stroke

Botulinum Toxin

Intervention	Motor Function	ADLs	Spasticity	Functional Ambulation	Gait
Botulinum Toxin A	1a 2 RCTs ✓	1b 1 RCT ✓	1a 5 RCTs ✓	1a 4 RCTs ↻	1a 2 RCTs ↻

Conclusions

1. ***Botulinum Toxin A injections used to treat focal spasticity has been shown to improve spasticity when compared to conventional care.***
2. ***There is less evidence to show it improves motor function in the lower extremity.***
3. ***Botulinum Toxin A may improve functional ambulation and gait.***

Additional Conclusions

4. ***Botulinum toxin injection reduces lower limb spasticity post stroke compared to placebo or nerve block.***
5. ***Botulinum toxin injection is more effective in combination with an ankle foot orthosis, but not with electrical stimulation, taping, or stretching.***
6. ***Botulinum toxin injection may be more effective in higher dosages, but is not impacted by location of injection.***
7. ***Botulinum toxin injection guided by ultrasonography may be more effective than by electrical stimulation or palpation.***

Key Studies on Botulinum Toxin to Treat Spasticity

- Pittock SJ, Moore AP, Hardiman O et al. A double-blind randomised placebo-controlled evaluation of three doses of botulinum toxin type A (Dysport®) in the treatment of spastic equinovarus deformity after stroke. Cerebrovasc Dis 2003; 15:289-30.
- Foley N, Murie-Fernandez M, Speechley M, Salter K, Sequeira K, Teasell R. Does the treatment of spastic equinovarus deformity following stroke with botulinum toxin increase gait velocity? A systematic review and meta-analysis. Eur J Neurol (2010); 17(12):1419-1427.
- Picelli A, Dambruoso F, Bronzato M, Barausse M, Gandolfi M, Smania N. Efficacy of therapeutic ultrasound and transcutaneous electrical nerve stimulation compared with botulinum toxin type A in the treatment of spastic equinus in adults with chronic stroke: a pilot randomized controlled trial. Top Stroke Rehabilitation 2014; 21(S1):8-16.

Oral Anti-Spastic Medications in the Lower Extremity

Intervention	Motor Function	ADLs	Spasticity
Oral Anti-Spastic Medications	1b 1 RCT ✗	1a 3 RCTs ↻	1a 4 RCTs ✓

Conclusions

1. ***Oral medications are effective interventions for reducing lower limb spasticity post stroke, although some may be associated with side effects.***
2. ***Oral anti-spastic medications may improve ADLs.***

Key Studies for Oral Anti-Spasticity Medications

- Stamenova P, Koytchev R, Kuhn K et al. A randomized, double-blind, placebo-controlled study of the efficacy and safety of tolperisone in spasticity following cerebral stroke. European Journal of Neurology (2005); 12(6):453-61.

TENS/NMES and Spasticity

Conclusions

1. ***Transcutaneous electrical stimulation is an effective intervention for reducing lower limb spasticity post stroke.***
2. ***Neuromuscular/functional electrical stimulation may not be effective.***

Key Studies for TENS/NMES and Spasticity

- Bakhtiary AH, Fatemy E. Does electrical stimulation reduce spasticity after stroke? A randomized controlled study. Clinical Rehabilitation 2008; 22(5):418-25.
- Tekeolu YB, Adak B, Göksoy T. Effect of transcutaneous electrical nerve stimulation (TENS) on Barthel Activities of Daily Living (ADL) index score following stroke. Clinical Rehabilitation. 1998;12(4):277-80.

3. Hemiplegic Upper Extremity Motor Rehabilitation

(Evidence Reviews Chapters 10-11 and Clinician's Handbook Chapter 4)

Upper Extremity Outcome Measure Categories

Category	Rationale	Individual Assessment Tools
Motor Function 	Assess gross motor movements and a series of general impairment measures when using the upper extremities	• Action Research Arm Test (ARAT) • Fugl-Meyer Assessment (FMA) • Rivermead Mobility Assessment (RMA) • Wolf Motor Function Test (WMFT)
Global Stroke Severity 	Assess the severity of stroke through global assessment of deficits post stroke.	• Brunnstrom Recovery Stages (BRS) • Modified Rankin Scale (MRS) • National Institutes of Health Stroke Scale (NIHSS) •
Muscle Strength 	Assess muscle power and strength during movement and tasks.	• Hand Grip Strength • Isokinetic Peak Torque (IPT) • Manual Muscle Strength Test (MMST) • Medical Research Council Scale (MRCS)
Dexterity 	Assess fine motor and manual skills through a variety of tasks, particularly with the use of the hand.	• Box and Block Test (BBT) • Finger to Nose Test (FNT) • Minnesota Manual Dexterity Test (MMDT) • Nine Hole Peg Test (9HPT) • Purdue Pegboard Test (PPT)
Range of Motion 	Assess ability to freely move upper extremity at joints both passively and actively	• Active Range of Motion (AROM) • Maximal Elbow Extension Angle During Reach (MEEAR) • Passive Range of Motion (PROM)
Proprioception 	Assess bodily sensory awareness and location of limbs.	• Joint Position Sense Test (JPST) • Revised Nottingham Sensory Assessment (RNSA)
Activities of Daily Living 	Assess performance and level of independence in various everyday tasks.	• Barthel Index (BI) • Canadian Occupational Performance Measure (COPM) • Chedoke Arm and Hand Activity Inventory (CAHAI) • Functional Independence Measure (FIM) • Modified Barthel Index (mBI) • Motor Activity Log (MAL) • Stroke Impact Scale (SIS)
Spasticity 		• Ashworth Scale (AS) • Modified Ashworth Scale (mAS)

Enhanced or More Intensive Therapy in Upper Extremity

Conclusion

1. ***Additional upper limb therapy does not appear to be superior to conventional therapy for improving upper limb motor function or functional independence.***

Key Studies for Intensive Therapy

- Rodgers H, Mackintosh J, Price C, Wood R, McNamee P, Fearon T, Marritt A, Curless R. Does an early increased-intensity interdisciplinary upper limb therapy programme following acute stroke improve outcome? Clin Rehabil 2003; 17(6):579-89.
- Harris JE, Eng JJ, Miller WC, Dawson AS. A self-administered Graded Repetitive Arm Supplementary Program (GRASP) improves arm function during inpatient stroke rehabilitation: a multi-site randomized controlled trial. Stroke 2009; 40:2123-2128.
- English C, Bernhardt J, Crotty M, Esterman A, Segal L, Hillier S. Circuit class therapy or seven-day week therapy for increasing rehabilitation intensity of therapy after stroke (CIRCIT): a randomized controlled trial. International Journal of Stroke 2015; 10(4):594-602.

Repetitive Task-Specific Techniques for Upper Extremity

Intervention	Motor Function	ADLs	Spasticity	ROM	Global Stroke Severity	Muscle Strength
Task Specific Training	1a 11 RCTs ✓	1a RCTs ✗	1a 2 RCTs ✓	1b 1 RCT ✓	1b 1 RCT ✗	1b 2 RCTs ✓

Conclusion

1. ***Task-specific training, alone or in combination with other therapy approaches, may be beneficial for improving motor function, spasticity, range of motion and muscle strength, but not stroke severity or ADLs.***

Key Study for Task Specific Training

- Arya KN, Verma R, Garg RK, Sharma VP, Agarwal M, Aggarwal GG. Meaningful task specific training (MTST) for stroke rehabilitation: a randomized controlled trial. Top Stroke Rehabil 2012; 19:193-211.

Strength Training

Intervention	Motor Function	Dexterity	ADLs	Spasticity	ROM	Muscle Strength
Strength Training	1a 6 RCTs ✓	1b 2 RCTs ✗	1b 2 RCTs ⟳	1b 2 RCTs ✗	1a 4 RCTs ✓	1a 3 RCTs ⟳

Conclusions

1. ***Strength training may improve motor function and range of motion, but not dexterity or spasticity.***
2. ***The literature is mixed regarding strength training and functional strength for improving ADLs, and muscle strength.***

Key Study for Strength Training

- Winstein CJ, Rose DK, Tan SM, Lewthwaite R, Chui HC, Azen SP. A randomized controlled comparison of upper-extremity rehabilitation strategies in acute stroke: a pilot study of immediate and long-term outcomes. Archives of Physical Medicine and Rehabilitation 2004; 85(4):620-628.

Constraint-Induced Movement Therapy (CIMT)

CIMT in Subacute Phase

Intervention	Motor Function	Dexterity	ADLs	Spasticity	Proprio-ception	Muscle Strength
CIMT in Subacute Phase	1a 8 RCTs ✗	1a 4 RCTs ↻	1a 8 RCTs ↻	2 1 RCT ✓		1b 1 RCT ✓
mCIMT in Subacute Phase	1a 7 RCTs ↻	1b 1 RCT ✗	1a 6 RCTs ✗	1b 1 RCT ✗	1b 2 RCTs ✗	1a 2 RCTs ✗

Conclusions

1. ***Constraint induced movement therapy in the acute/subacute phase may be beneficial for improving spasticity and muscle strength, but not motor function.***
2. ***The literature is mixed regarding improvement on ADLs and dexterity.***
3. ***Modified constraint-induced movement therapy in the acute/subacute phase is beneficial for improving motor function,***
4. ***It is not yet been shown to be beneficial in improving ADLs, dexterity, spasticity, proprioception or muscle strength.***

Key Study for CIMT in Subacute Phase

- Dromerick AW, Lang CE, Birkenmeier RL, Wagner JM, Miller JP, Videen TO, Powers WJ, Wolf SL, Edwards DF. Very Early Constraint-Induced Movement during Stroke Rehabilitation (VECTORS) Trial. Neurology 2009; 73:195-201.

CIMT in Chronic Phase

Intervention	Motor Function	ADLs	Muscle Strength
CIMT during the chronic phase	1a 13 RCTs ✓	1a 11 RCTs ✓	1a 2 RCTs ✓
mCIMT during the chronic phase	1a 10 RCTs ✓	1a 8 RCTs ✓	

Conclusions

1. ***Constraint-induced movement therapy may be beneficial for improving motor function, ADLs and muscle strength in the chronic phase following stroke.***
2. ***Modified constraint-induced movement therapy may be beneficial for improving motor function and ADLs in the chronic phase following stroke.***

Key Studies for CIMT in Chronic Phase

- Taub E, Miller NE, Novack TA, Cook EW, Fleming WC, Nepomuceno CS, Connell JS, Crago JE. Technique to improve chronic motor deficit after stroke. Arch Phys Med Rehabil 1993; 74:347-354.
- Suputtitada A, Suwanwela NC, Tumvitee S. Effectiveness of constraint-induced movement therapy in chronic stroke patients. J Med Assoc Thai 2004; 87:1482-1490.
- Van der Lee JH, Wagenaar RC, Lankhorst GJ, Vogelaar TW, Deville WL, Bouter LM. Forced use of the upper extremity in chronic stroke patients: results from a single-blind randomized clinical trial. Stroke 1999; 30:2369-2375.
- Wolf SL, Winstein CJ, Miller JP, Taub E, Uswatte G, Morris D, Giuliani C, Light KE, Nichols-Larsen D. Effect of Constraint-Induced Movement Therapy on Upper Extremity Function 3 to 9 months after stroke. JAMA 2006; 296:2095-2104 (EXCITE Trial).
- Wolf SL, Thompson PA, Winstein CJ, Miller JP, Blanton SR, Nichols-Larsen DS, Morris DM, Uswatte G, Taub E, Light KE, Sawaki L. The EXCITE Stroke Trial. Comparing Early and Delayed Constraint-Induced Movement Therapy. Stroke 2010; 41(10):2309-2315.

Priming the Motor System

Action Observation

Intervention	Motor Function	Dexterity	ADLs	Spasticity	Muscle Strength
Action Observation	1a 6 RCTs ↻	1a 3 RCTs ✓	1b 4 RCTs ↻	2 1 RCT ✓	1b 1 RCT ✗

Conclusion

1. ***Action observation may be beneficial for improving dexterity and spasticity, but not muscle strength. The evidence is mixed regarding improvement for motor function and ADLs.***

Key Study for Action Observation

- Franceschini M, Ceravolo MG, Agosti M, Cavallini P, Bonassi S, Dall'Armi V, Massucci M, Schifini F, Sale P. Clinical relevance of action observation in upper-limb stroke rehabilitation: a possible role in recovery of functional dexterity. A randomized clinical trial. Neurorehabil Neural Repair 2012; 26(5):456-462.

Mirror Therapy

Intervention	Motor Function	Dexterity	ADLs	Spasticity	Proprio-ception	Stroke Severity	Muscle Strength
Mirror therapy	1a 15 RCTs ✓	1b 2 RCTs ✓	1a 11 RCTs ⟳	1a 6 RCTs ⟳	1b 1 RCT ✓	1a 5 RCTs ✓	1a 2 RCTs ⟳

Conclusion

1. ***Mirror therapy may improve motor function, dexterity proprioception and stroke severity, but the literature is mixed regarding improvements in ADLs, spasticity and muscle strength.***

Key Study for Mirror Therapy

- Yavuzer G, Selles R, Sezer N, Sutbeyaz S, Bussmann JB, Koseoglu F, Atay MB, Stam HJ. Mirror therapy improves hand function in subacute stroke: a randomized controlled trial. Arch Phys Med Rehabil 2008; 89(3):393-398.

Mental Practice

Intervention	Motor Function	ADLs	Muscle Strength
Mental practice	1a 15 RCTs ✓	1a 6 RCTs ⟳	2 2 RCTs ✓

Conclusion

1. ***Mental practice may produce improvements in motor function and muscle strength, but the evidence is mixed regarding improvements in ADLs.***

Key Study for Mental Practice

- Letswaart M, Johnston M, Dijkerman HC et al. Mental practice with motor imagery in stroke recovery: randomized controlled trial of efficacy. Brain 2011; 134(5):1373-1386.

Bilateral Arm Training

Intervention	Motor Function	Dexterity	ADLs	Muscle Strength
Bilateral Arm Training	1a 4 RCTs ✓	1a 2 RCTs ⟳	1a 3 RCTs ⟳	1a 2 RCTs ✗

Conclusion

1. ***Bilateral arm training may improve motor function, but not muscle strength. The literature is mixed regarding bilateral arm training for improving dexterity and ADLs.***

Key Studies for Bilateral Arm Training

- Morris JH, van WF, Joice S, Ogston SA, Cole I, MacWalter RS. A comparison of bilateral and unilateral upper-limb task training in early poststroke rehabilitation: a randomized controlled trial. Arch Phys Med Rehabil 2008; 89:1237-1245.
- Morris JH, Van WF. Responses of the less affected arm to bilateral upper limb task training in early rehabilitation after stroke: A randomized controlled trial. Arch Phys Med Rehabil 2012; 93(7):1129-37.
- Whitall J, Waller SM, Sorkin JD, Forrester LW, Macko RF, Hanley DF, Goldberg AP, Luft A. Bilateral and unilateral arm training improve motor function through differing neuroplastic mechanisms: a single-blinded randomized controlled trial. Neurorehabil Neural Repair 2011; 25(2):118-129.

Music Therapy

Intervention	Motor Function	Dexterity	ADLs	ROM	Muscle Strength
Music therapy	1b 4 RCTs ⟳	2 3 RCTs ⟳	2 1 RCT ✗	2 1 RCT ✓	2 2 RCTs ✗

Conclusions

1. ***Overall, the literature is mixed regarding music therapy for upper limb rehabilitation post stroke.***
2. ***It should be noted that many of the studies in this section differ significantly on the implementation of music therapy.***

Key Study in Music Therapy

- Altenmuller E, Marco-Pallares J, Munte TF, Schneider S. Neural reorganization underlies improvement in stroke-induced motor dysfunction by music-supported therapy. Ann NY Acad Sci 2009; 1169:395-405.

Sensory Stimulation and Sensorimotor Training of the Upper Extremity

Transcutaneous Electrical Nerve Stimulation (TENS)

Intervention	Motor Function	Dexterity	ADLs	Muscle Strength
TENS	1a 10 RCTs	1a 2 RCTs	1a 3 RCTs	1a 5 RCTs

Conclusion

1. ***TENS may be beneficial for improving motor function, but the evidence is mixed regarding improvement in dexterity, ADLs and muscle strength.***

Key Study for TENS

- Tekeoglu Y, Adak B, Goksoy T. Effect of transcutaneous electrical nerve stimulation (TENS) on Barthel Activities of Daily Living (ADL) index score following stroke. Clinical Rehabilitation 1998; 12(4):277-280.

Electroacupuncture

Intervention	Motor Function	ADLs	Spasticity	Global Stroke Severity	Muscle Strength
Electro-Acupuncture	1a 6 RCTs	1a 3 RCTs	1a 5 RCTs	1a 2 RCTs	1b 1 RCT

Conclusion

1. ***Electroacupuncture improves spasticity and may improve motor function, stroke severity and muscle strength, but not ADLs.***

Acupuncture

Intervention	Motor Function	ADLs	Spasticity	ROM	Global Stroke Severity
Acupuncture	1a 8 RCTs	1a 7 RCTs	1a 3 RCTs	1a 2 RCTs	1a 4 RCTs

Conclusion

1. ***Acupuncture likely does not improve upper limb motor function or level of independence. It does appear to improve spasticity.***

Key Studies in Acupuncture

- Bai Yl, Li L, Hu YS, Wu Y. Xie PJ, Wang SW, Yang M, Xu YM, Zhu B. Prospective randomized controlled trial of physiotherapy and acupuncture on motor function and daily activities with ischemic stroke. J. Altern. Complement. Med 2013; 19(8):684-689.
- Chen L, Fang J, Ma R, et al. Additional effects of acupuncture on early comprehensive rehabilitation in patients with mild to moderate acute ischemic stroke: a multicenter randomized controlled trial. BMC Complementary Alternative Medicine 2016; 16: 226 (a).
- Zhuangl LX, Xu SF, D'Adamo CR, Jia C, He J, Han DX, Lao LX. An effectiveness study comparing acupuncture, physiotherapy, and their combination in poststroke rehabilitation: A multicentered, randomized, controlled clinical trial. Alternative Therapies in Health & Medicine 2012; 18(3).

EMG / Biofeedback in Hemiparetic Upper Extremity

Intervention	Motor Function	Dexterity	ADLs	Spasticity	ROM	Stroke Severity	Muscle Strength
EMG Biofeedback	1a 8 RCTs ✕	1b 1 RCT ✕	1a 3 RCTs ↻	2 2 RCTs ✕	1 4 RCTs ↻	1b 2 RCTs ↻	1b 2 RCTs ↻

Conclusion

1. ***The literature is mixed regarding EMG biofeedback alone for improving ADLs, ROM, stroke severity and muscle strength, but does not appear to be beneficial for improving motor function, dexterity or spasticity.***

Motor Stimulation
Functional Electrical Stimulation and NMES

Intervention	Motor Function	Dexterity	ADLs	Spasticity	ROM	Stroke Severity	Muscle Strength
Cyclic NMES	1a 7 RCTs ✓		1a 3 RCTs ✗	1a 6 RCTs ⟳	1b 2 RCTs ⟳	1b 2 RCTs ✗	
EMG-NMES	1a 7 RCTs ✗	1b 4 RCTs ✓	1a 5 RCTs ⟳	2 1 RCT ✓	2 2 RCTs ✓		1a 2 RCTs ✗
FES	1a 11 RCTs ⟳	1b 1 RCT ✓	1a 5 RCTs ⟳	1a 8 RCTs ⟳	1b 4 RCTs ⟳	1a 2 RCTs ⟳	1b 1 RCT ✗

Conclusions

1. ***Cyclic NMES may be beneficial for improving motor function but not ADLs and muscle strength. The literature is mixed regarding improvements in spasticity and range of motion.***
2. ***EMG triggered NMES may be beneficial for improving dexterity, spasticity and range of motion, but not motor function and muscle strength.***
3. ***The literature is mixed regarding improvements in ADLs.***
4. ***FES may be beneficial for improving dexterity, but not muscle strength.***
5. ***The literature is mixed regarding improvements in motor function, ADLs, spasticity, range of motion and stroke severity.***

Key Studies for Functional Electrical Stimulation

- Powell J, Pandyan AD, Granat M, Cameron M, Stott DJ. Electrical stimulation of wrist extensors in post stroke hemiplegia. Stroke 1999; 30(7):1384-1389.
- Page SJ, Levin L, Hermann V, Dunning K, Levine P. Longer versus shorter daily durations of electrical stimulation during task-specific practice in moderately impaired stroke. Arch Phys Med Rehabil 2012; 93:200-206.

Brain Stimulation
Invasive Motor Cortex Stimulation (MCS)

Intervention	Motor Function	Dexterity	ADLs	Muscle Strength
Motor Cortex Stimulation	1a 4 RCTs ⟳	2 1 RCT ✓	1a 3 RCTs ⟳	2 1 RCT ✗

Conclusion

1. ***The literature is mixed concerning invasive motor cortex stimulation for improving upper limb rehabilitation post stroke.***

Key Study for Invasive Motor Cortex Stimulation

- Levy RM, Harvey RL, Kissela BM, Winstein CJ, Lutsep HL, Parrish TB, Cramer SC, Venkatesan L. Epidural Electrical Stimulation for Stroke Rehabilitation: Results of the Prospective, Multicenter, Randomized, Single-Blinded Everest Trial. Neurorehabil Neural Repair 2016: 30(2):107-119.

Repetitive Transcranial Magnetic Stimulation (rTMS)

Intervention	Motor Function	Dexterity	ADLs	Spasticity	ROM	Proprio-Caption	Stroke Severity	Muscle Strength
Low frequency rTMS	1a 20 RCTs ✓	1a 10 RCTs ✓	1a 9 RCTs ✓	1a 7 RCTs ✗	1a 2 RCTs ✗	1b 1 RCT ✓	1a 5 RCTs ✓	1a 10 RCTs ⟳
High frequency rTMS	1a 7 RCTs ✗	1a 4 RCTs ✓	1a 6 RCTs ✓				1a 6 RCTs ✓	1a 6 RCTs ✓
Bilateral rTMS	1b 1 RCT ⟳							

Conclusions

1. ***Low frequency rTMS may be beneficial for improving motor function, dexterity, ADLs, proprioception, stroke severity, but not spasticty or range of motion.***
2. ***High frequency rTMS may be beneficial for improving dexterity, ADLs, stroke severity and muscle strength, but not motor function.***

Key Studies for rTMS

- Long H, Wang H, Zhao C et al. Effects of combining high-and low-frequency repetitive transcranial magnetic stimulation on upper limb hemiparesis in the early phase of stroke. Restor Neurol Neurosci 2018; 36(1): 21-30.
- Du JL, Tian W, Liu, J et al. Effects of repetitive transcranial magnetic stimulation on motor recovery and motor cortex excitability in patients with stroke: a randomized controlled trial." Eur J Neurol 2016; 23(16):1666-1672.
- Li J, Meng XM, Li RY, Zhang R, Zhang Z, Du YF. Effects of different frequencies of repetitive transcranial magnetic stimulation on the recovery of upper limb motor dysfunction in patients with subacute cerebral infarction. Neural regeneration research 2016; 11(10):1584.

Transcranial Direct Current Stimulation (tDCS)

Intervention	Motor Function	Dexterity	ADLs	Spasticity	Stroke Severity	Muscle Strength
Anodal tDCS	1a 11 RCTs	1a 5 RCTs	1a 4 RCTs	1b 1 RCT	1b 1 RCT	1a 9 RCTs
Cathodal tDCS	1a 9 RCTs	1a 3 RCTs	1a 3 RCTs	1b 1 RCT	1a 2 RCTs	1a 6 RCTs
Dual tDCS	1a 4 RCTs	1a 5 RCTs	1b 1 RCT	1a 2 RCTs	1b 1 RCT	1a 4 RCTs

Conclusion

1. ***The literature is mixed for anodal, cathodal or dual (bilateral) transcranial direct current stimulation (tDCS), alone or in combination with other therapy approaches, for upper limb rehabilitation post stroke.***

Telerehabilitation

Intervention	Motor Function
Telerehabilitation	1a 2 RCTs

Conclusion

1. ***Home-based telerehabilitation interventions were not effective for improving upper limb motor function when compared to an active control.***

Key Studies for Telerehabilitation

- Emmerson KB, Harding KE, Taylor NF. Home exercise programmes supported by video and automated reminders compared with standard paper-based home exercise programmes in patients with stroke: a randomized controlled trial. Clin Rehabil 2017; 31(8):1068-1077.
- Wolf SL., Sahu K, Bay RC et al. The HAAPI (Home Arm Assistance Progression Initiative) trial: a novel robotics delivery approach in stroke rehabilitation. Neurorehabil and Neural Repair 2015; 29(10):958-968.
- Benvenuti F, Stuart M, Cappena V, Gabella S, Corsi S, Taviani A, Albino A, Marchese S, Weinrich M. Community-Based Exercise for Upper Limb Paresis: A Controlled Trial with Telerehabilitation. Neurorehabilitation and Neural Repair, 2014; 28(7):611-620.

Orthosis in Hemiparetic Upper Extremity

Intervention	Motor Function	Dexterity	ADLs	Spasticity	ROM	Muscle Strength
Orthotics	1a 5 RCTs ✗	1b 2 RCTs ✗	1a 4 RCT $\times_s$	1b 7 RCTs ✗	1a 5 RCTs ✓	1b 2 RCTs ✗

Conclusions

1. ***Splinting, taping, and orthoses likely do not improve upper limb motor function, dexterity, ADLs, spasticity or muscle strength but may improve range of motion.***

Key Studies for Hand Splinting

- Basaran A, Emre U, Karadavut KI, Balbaloglu O, Bulmus N. Hand splinting for poststroke spasticity: a randomized controlled trial. Top Stroke Rehabil 2012 Jul-Aug; 19(4):329-37.

Robotics in Rehabilitation of Upper Extremity

Intervention	Motor Function	Dexterity	ADLs	Spasticity	ROM	Proprio-ception	Muscle Strength
Various arm/ shoulder end-effectors	1a 17 RCTs ✗	1b 6 RCTs ✗	1a 16 RCTs ✗	1b 6 RCTs ✗			1a 9 RCTs ↻
Bi-Manu Track	1b 2 RCTs ↻	1b 1 RCT ✗	1b 1 RCT ✗				1b 1 RCT ✗
Arm/shoulder Exoskeletons	1a 4 RCTs ↻	1b 2 RCTs ✗	1b 2 RCTs ✗			1b 1 RCT ✓	1b 2 RCTs ↻
Hand end-effectors	1a 2 RCTs ↻	1a 2 RCTs ↻		1b 1 RCT ✗			
Hand Exoskeletons	1a 6 RCTs ↻	1a 4 RCTs ↻	1a 4 RCTs ✓	1b 1 RCT ✓	2 1 RCT ✓		1b 1 RCT ✓

Conclusions

1. ***Arm/shoulder end-effector or exoskeleton, alone or in combination with other therapy approaches, may not be beneficial for for upper limb rehabilitation following stroke.***

2. ***Hand end-effectors may not be beneficial for improving upper limb rehabilitation, but hand exoskeletons may be beneficial for improving ADLs, spasticity, range of motion and muscle strength.***
3. ***The evidence is mixed for hand exoskeleton's ability to improve motor function and dexterity.***

Key Studies for Robotics

- Lo A, Guarino PD, Richards LG, Haselkorn JK, Witterberg GI, Federman DG, Ringer RJ, Wagner TH, Krebs HJ, Volpe BT, Bever CT, Bravata DM, Duncan PW, Corn BH, Maffucci AD, Nadeau SE, Conroy SS, Powell JM, Huang GD. Robot-assisted therapy for long term upper limb impairment after stroke. N Eng Med J, 2010; 362:1777-1783.
- Prange GB, Kottink AI, Buurke et al. The effect of arm support combined with rehabilitation games on upper-extremity function in subacute stroke: a randomized controlled trial. Neurorehabil and Neural Repair 2015; 29(2):174-182.
- Mehrholz J, Hädrich A, Platz T, Kugler J, Pohl M. 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, Issue 6.Art. No.: CD006876. DOI: 10.1002/14651858.CD006876.pub3.

Virtual Reality

Intervention	Motor Function	ADLs	Dexterity	Spasticity	ROM	Stroke Severity	Muscle Strength
Virtual reality	1a 30 RCTs ✓	1a 7 RCTs ✗	1a 10 RCTs ✗	1a 4 RCTs ✗	2 2 RCTs ⟳	1b 1 RCTs ✓	1a 12 RCTs ✗

Conclusion

1. ***Virtual reality therapy may be more beneficial than conventional therapy for improving motor function and stroke severity, but not ADLs, dexterity, spasticity or muscle strength.***

Key Studies for Virtual Reality Therapy

- Kong KH, Loh YJ, Thia E, Chai A, Ng CY, Soh YM, Toh S, Tjan SY. Efficacy of a virtual reality commercial gaming device in upper limb recovery after stroke: A randomized, controlled study. Topics in Stroke Rehabilitation 2016; 23(5):333-340.
- Saposnik G et al. Efficacy and safety of non-immersive virtual reality exercising in stroke rehabilitation (EVREST): a randomised, multicentre, single-blind, controlled trial. Lancet Neurology 2016; 15(10): 1019-1027.
- Kiper P, Szczudlik A, Agostini M et al. Virtual reality for upper limb rehabilitation in subacute and chronic stroke: a randomized controlled trial. Arch Phys Med Rehabil 2018;99(5):834-842.
- Adie K, Schofield C, Berrow M, Wingham J, Humfryes J, Pritchard C, James M, Allison R. Does the use of Nintendo Wii SportsTM improve arm function? Trial of WiiTM in Stroke: a randomized controlled trial and economics analysis. Clinical rehabilitation. 2017; 31(2):173-85.

Medications

Antidepressants and Upper Extremity Function

Intervention	Motor Function	Dexterity	ADLs	Stroke Severity	Muscle Strength
Antidepressants	1a 3 RCTs	1a 2 RCTs	1b 1 RCT	1a 3 RCTs	1a 2 RCTs

Conclusion

1. ***Antidepressants may help improve impaired upper extremity motor function following a stroke, although more recent data is calling this into question.***

Key Studies for Antidepressants and Upper Extremity

- Chollet F, Tardy J, Albucher JF, Thalamus C, Berard E, Lamy C, Bejot Y, Deltour S, Jaillard A, Niclot P, Guillon B. Fluoxetine for motor recovery after acute ischaemic stroke (FLAME): a randomized placebo-controlled trial. The Lancet Neurology 2011; 10(2):123-130.
- Kim JS, Lee EJ, Chang DI, Park JH, Ahn SH, Cha JK, Heo JH, Sohn SI, Lee BC, Kim DE, Kim HY. Efficacy of early administration of escitalopram on depressive and emotional symptoms and neurological dysfunction after stroke: a multicentre, double-blind, randomised, placebo-controlled study. The Lancet Psychiatry. 2017; 4(1):33-41.
- Dennis M, Mead G, Forbes J, Graham C, Hackett M, Hankey GJ, House A, Lewis S, Lundström E, Sandercock P, Innes K. Effects of fluoxetine on functional outcomes after acute stroke (FOCUS): a pragmatic, double-blind, randomised, controlled trial. The Lancet. 2019 Jan 19;393(10168):265-74.

Peptides: Cerebrolysin

Intervention	Motor Function	ADLs	Stroke Severity
Cerebrolysin	1a 2 RCTs	1b 1 RCT	1b 1 RCT

Conclusion

1. ***Cerebrolysin may improve upper limb motor function, dexterity, and measures of independence/daily living.***

Key Studies for Cerebrolysin

- Muresanu DF, Heiss WD, Hoemberg V, Bajenaru O, Popescu CD, Vester JC, Rahlfs VW, Doppler E, Meier D, Moessler H, Guekht A. Cerebrolysin and Recovery After Stroke (CARS): A Randomized, Placebo-Controlled, Double-Blind, Multicenter Trial. Stroke 2016: 47(1):151-159.
- Chang WH, Park CH, Kim DY, Shin YI, Ko MH, Lee A, Jang SY, Kim YH. Cerebrolysin combined with rehabilitation promotes motor recovery in patients with severe motor impairment after stroke. BMC Neurol 2016; 16:31.

Treatment of Spasticity in the Upper Extremity Post Stroke

Botulinum Toxin in the Hemiplegic Upper Extremity

Intervention	Motor Function	Dexterity	Activities of Daily Living	Spasticity	ROM	Muscle Strength
Botulinum Toxin A	1a 8 RCTs ✗	1a 2 RCTs ✗	1a 10 RCTs ✗	1a 18 RCTs ✓	1a 4 RCTs ✗	1b 1 RCT ✓
Botulinum Toxin B			1b 1 RCT ✗	1a 2 RCTs ✗		

Conclusions

1. ***Botulinum A likely improves spasticity in the upper limb following stroke, but not range of motion or activities of daily living.***
2. ***The effect on general upper limb motor function is conflicting and less clear.***
3. ***Botulinum toxin A in combination with other types of therapeutic approaches may be beneficial for certain aspects of upper limb function.***
4. ***Botulinum toxin B has been less well studied to date in comparison to botulinum toxin A.***

Key Studies for Botulinum Toxin for Upper Extremity Spasticity

- Kaji R, Osako Y, Suyama K, Maeda T, Uechi Y, Iwasaki M. Botulinum toxin type A in post-stroke upper limb spasticity. Curr Med Res Opin 2010; 26(8):1983-1992.
- Shaw L, Price C, van Wijck, F, Shackley P, Steen N, Barnes M, Ford G, Graham L, Rodgers H. Botulinum Toxin for the Upper Limb after Stroke (BoTULS) Trial: effect on impairment, activity limitation, and pain. Stroke 2011; 42(5):1371-1379.
- Elovic E, Munin M, Kanovsky P, Hanschmann A, Hiersemenzel R, Marciniak C. Randomized, placebo-controlled trial of incobotulinumtoxina for upper-limb post-stroke spasticity. Muscle Nerve 2016;53(3):415-421.
- Brashear A, Gordon MF, Elovic E et al. Intramuscular injection of botulinum toxin for the treatment of wrist and finger spasticity after a stroke. N Engl J Med 2002; 347(6):395-400.
- Brashear A, McAfee AL, Kuhn ER, Fyffe J. Botulinum toxin type B in upper-limb post-stroke spasticity: a double-blind, placebo-controlled study. Arch Phys Med Rehabil 2004; 85:705-709.
- Foley N, Pereira S, Salter K, Murie-Fernandez M, Speechley M, Meyer M, Sequeira K, Miller T, Teasell R. Treatment with botulinum toxin improves upper extremity function post stroke? A systematic review and meta-analysis. Archives of Physical Medicine and Rehabilitation 2013; 94(5):977-989.

Hemiplegic Shoulder Pain

Conclusions

1. ***The association between shoulder subluxation and hemiplegic shoulder pain is unclear.***
2. ***Hemiplegic shoulder pain may be associated with spastic muscle imbalance and contracted shoulder.***
3. ***There is high variability in the reported frequency of hemiplegic shoulder pain.***
4. ***Sustained positioning and static stretching of the hemiplegic shoulder may not be effective in reducing pain or improving motor function.***
5. ***Active therapies for the hemiplegic shoulder may be effective in reducing pain, increasing range of motion, and improving motor function.***

6. ***While a wide variety of treatment options are available, it is unclear which is the most effective.***

Electrical Stimulation in Hemiplegic Shoulder Pain

Conclusions

1. ***Surface neuromuscular electrical stimulation may be effective in reducing subluxation and improving range of motion in the hemiplegic shoulder, although its effectiveness may be negatively correlated with stroke onset.***
2. ***Intramuscular neuromuscular electrical stimulation may be effective in reducing hemiplegic shoulder pain, although its effectiveness may be negatively correlated with stroke onset.***
3. ***Transcutaneous electrical nerve stimulation may be effective in improving range of motion in the hemiplegic shoulder, although it may only be effective at higher intensity.***
4. ***Functional electrical stimulation may be effective in reducing subluxation and improving motor function in the hemiplegic shoulder.***

Key Studies for Electrical Stimulation at Shoulder

- Church C, Price C, Pandyan AD, Huntley S, Curless R, Rodgers H. Randomized controlled trial to evaluate the effect of surface neuromuscular electrical stimulation to the shoulder after acute stroke. Stroke 2006; 37(12):29995-3001.

Botulinum Toxin Injections for the Hemiplegic Shoulder

Conclusion

1. ***Botulinum toxin may be effective in reducing pain and improving range of motion in the hemiplegic shoulder, but only when delivered in higher doses.***

4. Rehabilitation of Cognitive Impairment Post-Stroke

(Evidence Reviews Chapters 12-14 and Clinician's Handbook Chapter 5)

The Nature of Cognitive Impairment Post Stroke

Attention	•Focus attention, sustained attention, selective attention, divided attention
Memory	•Visual memory, auditory memory, working memory, eispodic memory, semantic memory, working memory, procedural memory
Executive Function	•Initiation, processing speed, problem solving, planning
Perception, praxis	•Visuo-spatial, visuo-perceptual, Unilateral neglect, inattention, apraxia, agnosia, prosopagnosia
Language	•Aphasia: Broca's, Wernicke's,transcortical motor/sensory or mixed, conductive, global

Vascular Cognitive Impairment (VCI)

Conclusions

1. ***Vascular cognitive impairment (VCI) is the current term that reflects the range of cognitive deficits due to the impact of cerebrovascular disease, including stroke.***
2. ***VCI without dementia reflects deficits in one or more domains not severe enough to cause functional decline, reflecting a single strategic lesion or multiple infarcts that impact functional activities.***
3. ***Impairments of attention, executive function, and processing speed appear to be a consistent pattern of deficits in all subtypes.***
4. ***Since 30% of all stroke survivors progress to a dementia syndrome, more research is needed to identify biomarkers for those at risk.***
5. ***The severity of white matter change is associated with poorer cognitive performance and increasing limitations in activities of daily living post stroke.***
6. ***Cognitive impairment is associated with decreased ADL and IADL function, and patients may require longer-term, ongoing rehabilitation.***

Prevalence of Dementia Post-Stroke

Conclusions

1. ***Following stroke, as many as two-thirds of patients experience cognitive impairment or decline.***
2. ***The presence of cognitive impairment is associated with a substantial increase in risk for dementia.***
3. ***Risk for developing dementia may be up to 10 times greater among individuals with stroke than for those without.***
4. ***At the time of stroke, 10% of patients may have existing dementia. Another 10% may develop dementia shortly after a first-ever stroke.***
5. ***More than 33% of patients may experience dementia after a recurrent stroke.***

Natural Course of Vascular Cognitive Impairment

Conclusions

1. ***While cognitive decline may progress post stroke, approximately 16-20% of patients with cognitive impairment improve.***
2. ***While most improvements occur in the first three months, recovery may continue for the first year post stroke.***
3. ***The presence of post-stroke cognitive impairment has been associated with a 3-fold increase in risk for mortality.***
4. ***Mortality rates among patients with stroke and dementia are 2 to 6 times greater than among those without dementia.***

Diagnosis of Vascular Cognitive Impairment

Conclusion

1. ***At present, there is no gold standard for the diagnosis and assessment of VCI. Harmonized standards for brief and more extensive testing protocols have been developed for clinical and research use.***

Screening and Assessment of Cognitive Impairment Post Stroke

Category	Rationale	Individual Assessment Tools
Attention 	These outcome measures assessed an individual's ability to attend as well as identify target stimuli and remain focused on a particular goal.	• Attentive Matrices Test • Colour Trails Test • Symbol Digit Substitution Test (Symbol Digit Modalities Test) • Trail-making Test A
Executive function 	These outcome measures assessed an individual's ability to plan, follow rules and self-monitor.	• Digit Span Test (Backward) • Stroop Interference Test • Trail-making Test B • Verbal Fluency Test • Wisconsin Card Sorting Task
Learning and Memory 	These outcomes measures assessed an individual's ability to explicitly and implicitly learn and recall information.	• 10-word recall test (RBANS) • Delayed Recognition Span Test (DRST) • Rivermead Behavioural Memory Test • Stroke Impact Scale (Memory Subsection) • Wechsler Memory Scale (WMS) • Word List Recall/Delayed Recall Test • Word List Memory Test
Global Cognition 	These outcome measures assessed an individual's overall cognitive processing capability factoring in multiple domains.	• Abbreviated Mental Test • Clock Drawing Test • Functional Independence Measure Cognitive Subscale (FIM-Cog) • Mini Mental Status Examination (MMSE) • Montreal Cognitive Assessment (MoCA) • Wechsler Adult Intelligence Scale (WAIS)
Visuospatial perception and orientation 	These outcome measures assessed an individual's ability to correctly process and mentally manipulate visuospatial information.	• Motor-Free Visual Perception Test (MVPT) • Rey-Osterrieth Complex Figure Test •
Amusia 	These outcome measures assessed an individual's ability to perceive pitch and recognize music.	• Montreal Battery of Amusia
Activities of Daily Living 	These outcome measures assessed an individual's proficiency at performing everyday activities.	• Barthel Index (BI) • Functional Independence Measure (FIM) • Lawton Instrumental Activities of Daily Life Scale • Stroke Impact Scale (ADL Subsection)

Pharmacotherapy for Vascular Cognitive Impairment

Disease-Modifying Pharmacological Management in VCI

Antihypertensives

Intervention	Attention	Learning and Memory	Global Cognition	ADLs
Antihypertensives	1b 1 RCT ✕	1b 1 RCT ✕	1a 3 RCTs ✕	1b 1 RCT ✕

Conclusions

1. ***The effect of treatment for hypertension on risk for cognitive decline and dementia is uncertain.***
2. ***In individuals with previous stroke or TIA, treatment has been associated with reduced risk.***
3. ***There is no evidence that one particular antihypertensive agent is superior to another for the prevention of cognitive decline.***

Key Studies for Hypertensives Improving Cognitive Outcomes

- Collaborative PR, Neal B, MacMahon S. Effects of blood pressure lowering with perindopril and indapamide therapy on dementia and cognitive decline in patients with cerebrovascular disease. Arch Intern Med. 2003; 163:1069-75.
- Diener HC, Sacco RL, Yusuf S, Cotton D, Ôunpuu S, Lawton WA, Palesch Y, Martin RH, Albers GW, Bath P, Bornstein N. Effects of aspirin plus extended-release dipyridamole versus clopidogrel and telmisartan on disability and cognitive function after recurrent stroke in patients with ischaemic stroke in the Prevention Regimen for Effectively Avoiding Second Strokes (PRoFESS) trial: a double-blind, active and placebo-controlled study. The Lancet Neurology. 2008; 7(10):875-84.

Symptomatic Pharmacological Management in VCI

Cholinesterase Inhibitors

Donepezil

Conclusions

1. ***Treatment with donepezil may improve cognitive and global function in patients with vascular dementia***.

Key Studies of Donepezil

- Black S, Roman GC, Geldmacher DS, Salloway S, Hecker J, Burns A, Perdomo C, Kumar D, Pratt R. Efficacy and tolerability of donepezil in vascular dementia: Positive results of a 24-week, multicenter, international, randomized, placebo-controlled clinical trial. Stroke 2003; 34(10):2323-2330.
- Wilkinson D, Doody R, Helme R, Taubman K, Mintzer J, Kertesz A, Pratt RD. Donepezil 308 Study Group. Donepezil in vascular dementia: a randomized, placebo-controlled study. Neurology 2003; 61(4):479-486.

Rivastigmine

Intervention	Attention	Executive Function	Learning and Memory	Global Cognition	ADLs
Rivastigmine	1b 1 RCT ✕	1b 1 RCT ✕	1b 1 RCT ✕	1b 1 RCT ✕	1b 1 RCT ✕

Conclusion

1. ***Treatment with rivastigmine may stabilize cognitive performance and improve behaviour in patients with vascular dementia. Further research is required.***

Key Study for Rivastigmine

- Ballard C, Sauter M, Scheltens P, He Y, Barkhof F, Van Straaten EC, Van Der Flier WM, Hsu C, Wu S, Lane R. Efficacy, safety and tolerability of rivastigmine capsules in patients with probable vascular dementia: the VantagE study. Current medical research and opinion. 2008; 24(9):2561-74.

Galantamine

Conclusion

1. ***Treatment with galantamine may improve cognitive and global function in patients with mixed dementia.***
2. ***However, its impact on patients with post-stroke cognitive impairments is less clear.***

Key Studies for Galantamine

- Auchus AP, Brashear HR, Salloway S, Korczyn AD, De Deyn PP, Gassmann-Mayer C. Galantamine treatment of vascular dementia: a randomized trial. Neurology. 2007; 69(5):448-58.
- Erkinjuntti T, Kurz A, Gauthier S, Bullock R, Lilienfeld S, Damaraju CV. Efficacy of galantamine in probable vascular dementia and Alzheimer's disease combined with cerebrovascular disease: a randomised trial. Lancet 2002; 359:1283-1290.

Summary Comments on Cholinesterase Inhibitors

Conclusions

1. ***Three reversible acetylcholinesterase inhibitors, donepezil, rivastigmine, and galantamine, have been investigated in the treatment of vascular dementia.***
2. ***Donepezil and galantamine can be helpful in VaD or mixed Alzheimer's disease and cerebrovascular disease. Limited evidence for treatment with rivastigmine.***
3. ***Although there is strong evidence that Donepezil is effective in vascular dementia; several meta-analyses have not recommended these drugs for Mild Cognitive Impairment which is what is most common post stroke (Tricco et al., 2013; Russ & Morling, 2012; Birks & Flicker, 2006)***

Nimotidine in Vascular Dementia

Intervention	Learning and Memory	Global Cognition	ADLs
Nimodipine	1b 1 RCT ✓	1b 1 RCT ✓	1b 1 RCT ✗

Conclusions

1. ***Nimodipine may be beneficial for improving learning and memory, and global cognition.***
2. ***Nimodipine may not be beneficial for improving activities of daily living.***

Key Study for Nimodipine

- Sze KH, Sim TC, Wong E, Cheng S, Woo J. Effect of nimodipine on memory after cerebral infarction. Acta neurologica scandinavica. 1998; 97(6):386-92.

Memantidine in Vascular Dementia

Conclusion

1. ***Treatment with memantine may be associated with stabilization or improvement of cognitive function in patients with vascular dementia.***

Key Studies for Memantidine

- Orgogozo JM, Rigaud AS, Stöffler A, Möbius HJ, Forette F. Efficacy and safety of memantine in patients with mild to moderate vascular dementia: a randomized, placebo-controlled trial (MMM 300). Stroke. 2002; 33(7):1834-9.
- Wilcock G, Möbius HJ, Stöffler AM. A double-blind, placebo-controlled multicentre study of memantine in mild to moderate vascular dementia (MMM500). International clinical psychopharmacology. 2002; 17(6):297-305.

Pentoxyfylline in Vascular Dementia

Conclusion

1. ***Treatment with pentoxifylline may improve cognitive function in patients with multi-infarct dementia.***

Key Studies for Pentoxyfylline

- Oizumi K, Baumann P, Siira P, Vanharanta H, Myllylä VV, Chiu MJ, Chen RC, Tseng CY, Rossi A, Iidaka T, Nakajima T. European pentoxifylline multi-infarct dementia study. European Neurology 1996; 36(5):315-21.

Antidepressants

Intervention	Attention	Executive Function	Learning and Memory	Global Cognition	Visual-Spatial
Antidepressants	1b 1 RCT ✗	1b 1 RCT ✗	1b 1 RCT ✓	1b 1 RCT ↻	1b 1 RCT ✗

Conclusions

1. ***Antidepressants may be beneficial for improving learning and memory but may not be beneficial for improving other cognitive outcomes.***

Key Study of Antidepressants for Cognition

- Jorge RE, Acion L, Moser D, Adams HP, Robinson RG. Escitalopram and enhancement of cognitive recovery following stroke. Archives of general psychiatry. 2010 Feb 1;67(2):187-96.

Impact of Depression on Cognitive Disorders

Conclusions

1. ***It is unclear whether depression is associated with cognitive impairment post stroke.***
2. ***Depression-related cognitive impairment can sometimes mimic the signs of dementia and is referred to as pseudodementia.***
3. ***Pseudodementia tends to be more sudden onset, more rapid progression, with a previous history of depression.***
4. ***It is characterized by more variable, effort-related cognitive deficits with little nocturnal exacerbation.***

Feature	Dementia	Pseudodementia
Onset	Often insidious	Usually acute or subacute
Progression	Usually slow, early changes often missed	Usually rapid
Symptom duration at presentation	Long	Short
Psychiatric history or recent life crisis	Uncommon	Common
Extensive self-report of mental impairment	Uncommon	Common
Mental status or psychometric testing	Progressive decline	Variable, effort-related
Memory impairment	Common, most severe for recent events	Common, often selective amnesia, inconsistent deficits over time

Cognitive Rehabilitation for Attention, Memory, Executive Function Post Stroke

Interventions for cognitive rehabilitation are broadly classified as:

1. ***Direct remediation/cognitive skill training to re-establish previously learned patterns of behaviour.***
2. ***Compensatory strategy training, either establishing new patterns of cognitive activity through internal compensatory cognitive mechanisms or establishing new patterns of activity through external compensatory mechanisms such as external aids, environmental structuring and support.***

Remediation of Attention

Intervention	Attention	Executive Function	Learning and Memory	ADLs
Attentional Training	**1b** **2 RCTs** ✓	**1b** **1 RCT** ✗	**1b** **1 RCT** ✗	**1b** **1 RCT** ✗

Conclusions

1. ***Attention training may have a positive effect on specific, targeted outcomes but overall attentional training may not be helpful for improving attentional deficits.***
2. ***Further research within the stroke population is required using like outcome measures to better evaluate comparisons between studies.***

Key Studies for Attentional Training

- Mazer BL, Sofer S, Korner-Bitensky N, Gelinas I, Hanley J, Wood-Dauphinee S. Effectiveness of a visual attention retraining program on the driving performance of clients with stroke. Arch Phys Med Rehabil 2003; 84(4):541-550.
- Barker-Collo SL, Feigin VL, Lawe CM, Parag V, Senior H, Rodgers A. Reducing attention deficits after stroke using attention process training; A randomized controlled trial. Stroke 2009; 40:3293-3298.

Remediation of Memory Deficits

Intervention	Attention	Executive Function	Learning and Memory	Global Cognition
Memory Training	**1b** **1 RCT** ✓	**1b** **1 RCT** ✗	**1b** **1 RCT** ↻	**1b** **1 RCT** ↻

Conclusions

1. ***Compensatory strategies can be used to improve memory outcomes post stroke. Further research within the stroke population is required.***
2. ***There is limited research investigating group therapy post stroke, and little evidence supporting the use of group-based interventions for the improvement of memory***

Key Study for Remediation of Memory Deficits

- Aben L, Heijenbrok-Kal MH, Ponds RW, Busschbach JJ, Ribbers GM. Long-lasting effects of a new memory self-efficacy training for stroke patients: a randomized controlled trial. Neurorehabilitation and neural repair. 2014; 28(3):199-206.

Remediation of Executive Functioning and Problem Solving

Interventions	Learning and Memory	Global Cognition	ADLs
Occupational Workplace Interventions		1b 1 RCT ✗	1b 1 RCT ✗
Trial and Error Learning	2 1 RCT ✗		2 1 RCT ↻
Problem Solving Therapy			1b 1 RCT ✗

Conclusions

1. ***The standardization of both intervention and outcome measures would help resolve the conflicts seen between individual studies.***
2. ***Analogical problem-solving skills training may improve problem solving abilities and instrumental activities of daily living, but there is conflicting evidence.***
3. ***Tailored interventions to improve return to work are not effective in improving cognition.***

Key Study for Remediation of Executive Function and Problem Solving

- Chung CSY, Pollock A, Campbell T, Durward BR, Hagen S. Cognitive rehabilitation for executive dysfunction in adults with stroke or other adult non-progressive acquired brain damage. Cochrane Database of Systematic Reviews 2013, Issue 4. Art. No.: CD008391. DOI: 10.1002/14651858.CD008391.pub2.

Physical Activity and Cognition

Interventions	Attention	Executive Function	Learning and Memory	Global Cognition	ADLs
Exercise Programs	1a 4 RCTs ✗	1a 4 RCTs ✗	1a 4 RCTs ✓	1a 3 RCTs ✓	1b 1 RCT ✗

Conclusions

1. ***Exercise may be beneficial for improving learning and memory, and overall cognitive abilities.***
2. ***Exercise may not be beneficial for improving attention or executive function.***
3. ***Higher intensity exercises may not be more beneficial than lower intensity exercises for improving cognition.***

Key Study for Exercise and Cognition

- Tang A, Eng JJ, Tsang TS, Liu-Ambrose T. High-and low-intensity exercise do not improve cognitive function after stroke: A randomized controlled trial. Journal of rehabilitation medicine. 2016; 48(10):841-6.

Multimodal Treatment

Intervention	Executive Function	Learning and Memory	Global Cognition	Visual-Spatial	ADLs
Multimodal training (exercise and cognitive training)	**1b 1 RCT** ✓	**1b 1 RCT** ✓	**1a 2 RCTs** ✗	**1b 1 RCT** ✓	**1b 1 RCT** ✓

Conclusion

1. ***The literature is mixed regarding multimodal interventions for improving cognitive rehabilitation.***

Key Studies for Mutimodal Treatment of Cognitive Disorders

- Bo W, Lei M, Tao S, Jie LT, Qian L, Lin FQ, Ping WX. Effects of combined intervention of physical exercise and cognitive training on cognitive function in stroke survivors with vascular cognitive impairment: a randomized controlled trial. Clinical rehabilitation. 2019; 33(1):54-63.
- Cheng C, Liu X, Fan W, Bai X, Liu Z. Comprehensive rehabilitation training decreases cognitive impairment, anxiety, and depression in poststroke patients: a randomized, controlled study. Journal of Stroke and Cerebrovascular Diseases. 2018; 27(10):2613-22.

Mental Imagery

Intervention	Attention	Learning and Memory	ADLs
Mental Imagery	**1b 1 RCT** ✓	**2 1 RCT** ⟳	**1b 2 RCTs** ✓

Conclusions

1. ***Mental imagery may be beneficial for improving attention, and activities of daily living.***
2. ***Mental imagery may not be beneficial for improving learning and memory.***

Key Study for Mental Imagery and Cognitive Disorders

- Liu KP, Chan CC, Lee TM, Hui-Chan CW. Mental imagery for promoting relearning for people after stroke: a randomized controlled trial. Archives of physical medicine and rehabilitation. 2004; 85(9):1403-8.

Cognitive-Motor Interference

Intervention	Attention	Global Cognition	ADLs
Cognitive Motor Interference	1b 1 RCT ✗	1b 1 RCT ✓	1b 1 RCT ✗

Conclusion

1. ***The literature is mixed regarding cognitive-motor interference for cognitive rehabilitation.***

Key Study on Cognitive Motor Interference

- Liu KP, Chan CC. Pilot randomized controlled trial of self-regulation in promoting function in acute poststroke patients. Archives of physical medicine and rehabilitation. 2014 Jul 1;95(7):1262-7.

Music Impacting Cognition

Intervention	Attention	Executive Function	Learning and Memory	Global Cognition	Visual-Spatial	Amusia
Music Therapy	1b 1 RCT ✗	1b 1 RCT ✗	1b 1 RCT ✗	1b 1 RCT ✗	1b 1 RCT ✗	1b 1 RCT ✗

Conclusion

1. ***Music may not be helpful for improving cognitive function. Further research is required.***

Key Study for Music Therapy

- Särkämö T, Tervaniemi M, Laitinen S, Forsblom A, Soinila S, Mikkonen M, Autti T, Silvennoinen HM, Erkkilä J, Laine M, Peretz I. Music listening enhances cognitive recovery and mood after middle cerebral artery stroke. Brain. 2008; 131(3):866-76.

Computer-Based Cognitive Training

Intervention	Attention	Executive Function	Learning and Memory	Global Cognition	Visual-Spatial	ADLs
Computer Based Cognitive Training	1a 2 RCTs ✓	1a 4 RCTs ✗	1b 1 RCT ↻	1a 3 RCTs ✗	1b 1 RCT ✗	1a 2 RCTs ✗

Conclusions

1. ***The literature is mixed regarding computer-based training for improving attention.***

2. ***Computer -based training may not be helpful for improving executive function or global cognition.***

Key Study for Computer Training

- Wentink MM, Berger MA, de Kloet AJ, Meesters J, Band GP, Wolterbeek R, Goossens PH, Vliet Vlieland TP. The effects of an 8-week computer-based brain training programme on cognitive functioning, QoL and self-efficacy after stroke. Neuropsychological rehabilitation. 2016; 26(5-6):847-65.

Virtual Reality in Improving Cognition

Intervention	Attention	Executive Function	Learning and Memory	Global Cognition	Visual-Spatial	ADLs
Virtual Reality Training	2 1 RCT ✗	2 1 RCT ✗	2 1 RCT ✓	2 1 RCT ✗	2 1 RCT ✗	2 1 RCT ✗

Conclusion

1. ***Virtual reality may not be beneficial for improving cognition.***

Key Study for Virtual Reality

- Faria AL, Cameirão MS, Couras JF, Aguiar JR, Costa GM, Bermúdez i Badia S. Combined cognitive-motor rehabilitation in virtual reality improves motor outcomes in chronic stroke–a pilot study. Frontiers in psychology. 2018; 9:854.

Repetitive Transcranial Magnetic Stimulation (rTMS)

Intervention	Attention	Executive Function	Learning and Memory	Global Cognition	Visual-Spatial	ADLs
rTMS	1b 1 RCT ✗	1b 1 RCT ✗	1a 2 RCTs ↻	1b 1 RCT ✓	1b 1 RCT ✗	1b 1 RCT ✗

Conclusions

1. ***rTMS may have a positive effect on cognitive function following stroke although much of the research has not shown a positive effect.***
2. ***Further research is required to determine if this effect is a result of a specific placement or frequency of the rTMS therapy***

Key Study for rTMS

- Lu H, Zhang T, Wen M, Sun L. Impact of repetitive transcranial magnetic stimulation on post-stroke dysmnesia and the role of BDNF Val66Met SNP. Medical science monitor: international medical journal of experimental and clinical research. 2015; 21:761.

Transcranial Direct Current Stimulation (tDCS)

Intervention	Attention 	Learning and Memory 
tDCS	2 1 RCT ✕	1b 1 RCT 

Conclusion

1. *Anodal tDCS to the left dorsolateral prefrontal cortex may not help to improve working memory and attention. Further research is required.*

Acupuncture and Electroacupuncture

Interventions	Attention 	Executive Function 	Learning & Memory 	Global Cognition 	Visual-Spatial 	ADLs 
Acupuncture				1b 2 RCTs ✓		2 1 RCT ✓
Electroacupuncture	1b 1 RCT ✓	1b 1 RCT ✕	1b 1 RCT ✕	1b 1 RCT ✕	1b 1 RCT ✓	

Conclusions

1. *Acupuncture may be beneficial for improving global cognition and activities of daily living Electroacupuncture may be beneficial for improving attention, and visuospatial perception and orientation, but not other cognitive outcomes.*

4a. Rehabilitation of Perceptual Disorders Post-Stroke

Screening and Assessment Tests for Unilateral Neglect

Category	Rationale	Individual Assessment Tools
Visuospatial Processing & Neglect 	These outcome measures assessed visuospatial processing and orientation to examine neglect severity	• Behavioural Inattention Test (BIT) • Catherine Bergego Scale • Clock Drawing Test • Comb and Razor Test • Extinction Task • Line Cancellation (Line Bisection) Test • Motor-Free Visual Perception Test (MVPT) • Rey-Osterrieth Complex Figure Test • Single and Double-digit Cancellation • Verbal Cancellation Test (Letter Cancelation) • Visual Scanning Tasks
Learning and Memory 	These outcomes measures assessed an individual's ability to explicitly and implicitly learn and recall information	• Corsi Vertical Span Test
Global Cognition 	These outcome measures assessed an individual's overall cognitive processing capability factoring in multiple domains.	• Mini Mental Status Examination (MMSE) • Wechsler Adult Intelligence Scale (WAIS)
Motor Rehabilitation 	These outcome measures covered gross motor movements, as well as fine, dexterous movements when using the upper extremities.	• Action Research Arm Test (ARAT) • Box and Block Test (BBT) • Fugl-Meyer Assessment • Motricity Index • Nine Hole Peg Test (9HPT) • Rivermead Mobility Index (RMI) • Wolf Motor Function Test
Stroke Severity 	These outcome measures assessed the severity of one's stroke through a global assessment of a multitude of deficits a stroke survivor may experience.	• Canadian Neurological Scale (CNS) • National Institutes of Health Stroke Scale (NIHSS) • Modified Rankin Scale (MRS)
Activities of Daily Living 	These outcome measures assessed performance and level of independence in various everyday tasks	• Activities of Daily Living Questionnaire • Barthel Index (BI) • Functional Independence Measure (FIM)

Treatments of Spatial Neglect

Remedial Versus Compensatory Approach

Treatments of neglect can be divided into a remedial or compensatory approach

Remedial Treatments in Unilateral Spatial Neglect

Visual Scanning

Intervention	Visuospatial Processing & Neglect	Global Cognition	Motor Rehab	Stroke Severity	ADLs
Visual Scanning Training	1a 5 RCTs	1b 2 RCTs	1b 1 RCT	1b 1 RCT	1a 4 RCTs

Conclusions

1. ***The literature is mixed regarding visual scanning training for improving neglect.***
2. ***Visual scanning training may not be beneficial for improving activities of daily living.***

Key Articles on Visual Scanning

- Weinberg J, Diller L, Gordon WA, Gerstman LJ, Lieberman A, Lakin P, Hodges G, Ezrachi O. Training sensory awareness and spatial organization in people with right brain damage. Arch Phys Med Rehabil 1979; 60:491-496.
- Paolucci S, Antonucci G, Guariglia C, Magnotti L, Pizzamiglio L, Zoccolotti P. Facilitatory effect of neglect rehabilitation on the recovery of left hemiplegic stroke patients: a cross-over study. J Neurol 1996; 243:308-314.
- Chan DY, Man DW. Unilateral neglect in stroke: A comparative study. Topics in Geriatric Rehabilitation. 2013; 29(2):126-34.

Computer-Based Scanning in Neglect

Intervention	Visuospatial Processing & Neglect	Global Cognition	Motor Rehab	ADLs
Computer-Based Rehabilitation	1a 2 RCTs	1b 1 RCT	1b 1 RCT	1b 1 RCT

Conclusions

1. ***Computer-based visual scanning therapy for neglect does not appear to be effective in improving visual perception.***

Key Study for Computer-Based Visual Scanning

- Robertson IH, Gray JM, Pentland B, Waite LJ. Microcomputer based rehabilitation for unilateral left visual neglect: A randomized controlled trial. Arch Phys Med Rehabil 1990; 71:663-638.

Virtual Reality Therapy for Neglect

Conclusion

1. ***Virtual reality treatment for neglect appears to be effective in improving visual perception.***

Compensatory Approach in Unilateral Spatial Neglect

Prisms Adaptation for Neglect

Intervention	Visuospatial Processing & Neglect	Learning and Memory	ADLs
Prism Glasses	1a 10 RCTs	2 1 RCT	1b 1 RCT

Conclusion

1. ***Prismatic adaptation with a significant rightward shift appears to be beneficial for neglect; however, the long-term effect is unclear.***
2. ***The literature is mixed regarding prism adaptation training for improving neglect.***

Key Study for Prism Adaptation

- Rossi PW, Kheyfets S, Reding MJ. Fresnel prisms improve visual perception in stroke patients with homonymous hemianopia or unilateral visual neglect. Neurology 1990; 40(10):1597-1599.

Limb Activation in Neglect

Intervention	Visuospatial Processing & Neglect	Motor Rehab	ADLs
Limb Activation	1a 3 RCTs	1b 1 RCT	1b 1 RCT

Conclusions

1. ***Limb activation may not be beneficial for improving neglect.***

Key Studies on Limb Activation and Neglect

- Kalra L, Perez I, Gupta S, Wittink M. The influence of visual neglect on stroke rehabilitation. Stroke 1997; 28:1386-1391.

Rehabilitation of Perceptual Disorders Post-stroke

- Robertson IH, McMillan TM, MacLeod E, Edgeworth J, Brock D. Rehabilitation by limb activation training reduces left-sided motor impairment in unilateral neglect patients: A single-blind randomized control trial. Neuropsychological Rehabilitation 2002; 12:439-454.

Sensory Feedback Strategies for Neglect

Conclusions

1. ***The use of external sensory stimulation in the treatment of neglect may be beneficial, although evidence is limited.***
2. ***Electrical somatosensory stimulation may be a useful supplement to visual scanning training.***
3. ***Visuomotor feedback strategies appear to be beneficial in the treatment of neglect.***

Key Studies for Sensory Strategies for Neglect

- Fong KNK, Yang NYH, Chan MKL, Chan DYL, Lau AFC, Chan DYW, . . . Chan CCH. Combined effects of sensory cueing and limb activation on unilateral neglect in subacute left hemiplegic stroke patients: a randomized controlled pilot study. Clinical Rehabilitation 2013; 27(7):628-637.
- Polanowska K, Seniow J, Paprot E, Lesniak M, Czlonkowska A. Left-hand somatosensory stimulation combined with visual scanning training in rehabilitation for post-stroke hemineglect: a randomised, double-blind study. Neuropsychol Rehabil 2009; 19(3):364-382.

Mirror Therapy

Intervention	Visuospatial Processing & Neglect
Mirror Therapy	1b 1 RCT ✓

Conclusion

1. ***Visuomotor feedback strategies appear to be beneficial in the treatment of neglect.***
2. ***Mirror training may be beneficial for improving neglect.***

Key Study for Mirror Therapy in Neglect

- Pandian J, Arora R, Kaur P, Vishwambaran D, Arima H. Mirror therapy in unilateral neglect after stroke (MUST trial). Neurology 2014; 83(11):1012-1017.

Eye Patching and Hemispatial Glasses

Intervention	Visuospatial Processing & Neglect	Motor Rehab	Stroke Severity	ADLs
Eye Patching	1b 1 RCT ✗	1b 1 RCT ✗	2 1 RCT ✗	1b 3 RCTs ✓

Conclusions

1. ***Eye patching and hemispatial glasses may not be beneficial for neglect, stroke severity, motor rehabilitation.***
2. ***They may be beneficial for activities of daily living.***

Key Study for Eye Patching/Hemispatial Glasses

- Tsang MH, Sze KH, Fong KN. Occupational therapy treatment with right half-field eyepatching for patients with subacute stroke and unilateral neglect: a randomised controlled trial. Disabil Rehabil 2009; 31(8):630-637.

Caloric Stimulation

Conclusion

1. ***The effectiveness of caloric stimulation as part of a treatment intervention for unilateral spatial neglect has not been well studied.***

Galvanic Vestibular Stimulation

Intervention	Visuospatial Processing & Neglect
Galvanic Vestibular Stimulation	1a 5 RCTs ✗

Conclusions

1. ***Galvanic vestibular stimulation (GVS) may not be beneficial for improving neglect.***
2. ***There does not appear to be a difference in efficacy between left or right GVS, and high or low volume GVS.***

Optokinetic Stimulation

Intervention	Visuospatial Processing & Neglect	Stroke Severity	ADLs
Optokinetic Stimulation	1b 1 RCT ✓	2 1 RCT ✗	2 1 RCT ✗

Conclusions

1. ***The literature is mixed regarding optokinetic stimulation training for improving neglect.***
2. ***Although optokinetic stimulation appears to have a positive effect on neglect, it is uncertain whether the addition of optokinetic stimulation to a program of rehabilitation for neglect would be of benefit.***

Trunk Rotation Therapy

Intervention	Visuospatial Processing & Neglect	ADLs
Trunk Rotation Therapy	1b 1 RCT	1b 1 RCT

Conclusion

The literature is mixed concerning trunk rotation therapy for improving neglect and activities of daily living.

Neck Muscle Vibration

Intervention	Visuospatial Processing & Neglect	ADLs
Neck Muscle Vibration	2 1 RCT	2 1 RCT

Conclusion

1. ***The literature is mixed concerning visual exploration with neck muscle vibration for improving activities of daily living.***

Transcutaneous Electrical Nerve Stimulation (TENS)

Intervention	Visuospatial Processing & Neglect	Global Cognition	ADLs
TENS	1a 3 RCTs	2 1 RCT	1b 1 RCT

Conclusion

1. ***The literature is mixed concerning visual exploration with neck muscle vibration for improving activities of daily living.***

Repetitive Transcranial Magnetic Stimulation for Neglect

Intervention	Visuospatial Processing & Neglect	Motor Rehab	ADLs
rTMS	1a 5 RCTs	1a 3 RCTs	1b 1 RCT

Conclusions

1. ***The literature is mixed regarding rTMS for improving neglect and motor rehabilitation.***
2. ***rTMS may not be beneficial for improving activities of daily living.***

Key Study for rTMS and Neglect

- Yang NY, Fong KN, Li-Tsang CW, Zhou D. Effects of repetitive transcranial magnetic stimulation combined with sensory cueing on unilateral neglect in subacute patients with right hemispheric stroke: a randomized controlled study. Clinical rehabilitation. 2017; 31(9):1154-63.

Theta-Burst Stimulation

Intervention	Visual Spatial Processing & Neglect
Theta Burst Stimulation	1a 6 RCTs

Conclusions

1. ***TBS may be beneficial for improving neglect.***

Key Study for Theta Burst Stimulation

- Koch G, Bonni S, Giacobbe V, Bucchi G, Basile B, Lupo F, Versace V, Bozzali M, Caltagirone C. Theta-burst stimulation of the left hemisphere accelerates recovery of hemispatial neglect. Neurology. 2012; 78(1):24-30.

Transcranial Direct Current Stimulation

Intervention	Visuospatial Processing & Neglect
Transcranial Direct Current Stimulation	1b 1 RCT

Conclusion

1. ***tDCS may be beneficial for improving neglect.***

Key Study for tDCS

- Ko MH, Han SH, Park SH, Seo JH, Kim YH. Improvement of visual scanning after DC brain polarization of parietal cortex in stroke patients with spatial neglect. Neuroscience letters. 2008; 448(2):171-4.

Dopaminergic Drugs

Intervention	Visuospatial Processing & Neglect 	Learning and Memory 	Motor Rehab 
Dopamine	**1b** **1 RCT** ✗	**1b** **1 RCT** ✗	**1b** **1 RCT** ✗

Conclusion

1. ***Dopaminergic medication may not be beneficial for improving neglect, learning and memory, and motor rehabilitation.***

Key Study on Dopaminergic Drugs

- Gorgoraptis N, Mah YH, Machner B, Singh-Curry V, Malhotra P, Hadji-Michael M, Cohen D, Simister R, Nair A, Kulinskaya E, Ward N. The effects of the dopamine agonist rotigotine on hemispatial neglect following stroke. Brain. 2012; 135(8):2478-91.

4b. Rehabilitation of Aphasia Post-stroke

Assessment and Aphasia Outcomes

Category	Rationale	Individual Assessment Tools
Discourse 	These outcome measures assessed aspects of speech such as content and grammar, as well as the overall ability for giving instructions, storytelling or description.	• Cookie Theft Picture Description • Discourse Quality • Discourse Quantity, Word and Utterance Count • Speech Content Analysis
Naming 	These outcome measures assessed an individual's ability to retrieve and name certain objects. This includes fluency, convergent naming, divergent naming and confrontation naming.	• Boston Naming Test • Picture Naming and Category Test • Naming Tests (Fluency Tests) • Verbal Fluency Test
Verbal Fluency 	These outcome measures assessed the overall fluency of verbal expression. This includes aspects of speech such as prosody, the spontaneity of production or vocabulary and phase length.	• Mean Phrase Length • Mean Vocal Reaction Time • Melodic Intontation Therapy Task • Spontaneous Speech
Social Communication 	These outcome measures assess the more social aspects of communication, such as social appropriateness and turn-taking.	• Amsterdam-Nijmegen Everyday Language Test • Functional Communication Profile • Measure of Participation in Conversation • Speech Questionnaire
Repetition 	These outcome measures assess the ability for an individual to repeat a given word, phrase or text.	• Phonological Measures – repetition • Standardized Language Test
Writing 	These outcome measures are designed to assess the ability of an individual to produce written language.	• Written Language
General Comprehension 	These outcome measures assess an individual's ability to comprehend speech and/or language in multiple modalities.	• Gesture Comprehension • Semantic Association Test • Body-Part Identification • Discrimination Tasks
Reading Comprehension 	These outcome measures specifically assess comprehension of written language and alphanumeric symbols.	• Reading Comprehension Battery for Aphasia
Auditory Comprehension 	These outcome measures specifically assess comprehension of heard speech sounds.	• Complex Ideation • Miscellaneous Commands • Token Test

Rehabilitation of Aphasia

Global speech and Language 	These outcome measures are generally comprehensive aphasia batteries that examine multiple aspects of speech and language. Should the study report specific subscales of these batteries, they will be counted towards their corresponding category above.	• Aachen Aphasia Test • American Speech-Language Hearing Association Functional Assessment of Communication Skills • Aphasia Severity Rating Scale • Boston Diagnostic Aphasia Examination • Communicative Activities in Daily Living • Porch Index of Communicative Ability • Western Aphasia Battery
Apraxia 	These outcome measures assess apraxia impairment.	• Ideomotor Apraxia • Apraxia Battery for Adults
Activities of Daily Living 	These outcome measures assessed performance and level of independence in various everyday tasks.	• Barthel Index (BI) • Functional Independence Measure (FIM) • Therapy Outcome Measure – activity

Therapy of Aphasia Post-Stroke

Intervention	Discourse 	Naming 	Verbal Fluency 	Social Commun-ication 	Writing 	General Compre-hension 	Reading Compre-hension 	Auditory Compre-hension 	Global Speech & Language 	ADLs 
General Speech and Language Therapy	**2** **3 RCTs** ✗	**2** **3 RCTs** ✗	**2** **2 RCTs** ✗	**1a** **4 RCTs** ✗	**2** **1 RCT** ✓	**2** **2 RCTs** ✗	**2** **1 RCT** ✗	**2** **3 RCTs** ✗	**1a** **3 RCTs** ✗	**1b** **1 RCT** ✗

Conclusions

1. ***General speech and language therapy may improve writing in stroke survivors with aphasia.***
2. ***Speech and language therapy may not be beneficial for global speech and language or social communication, in addition to activities of daily living.***

Key Studies for General Speech and Language Therapy

- Lincoln NB, Mulley GP, Jones AC, McGuirk E, Lendrem W, Mitchell JR. Effectiveness of speech therapy for aphasic stroke patients: a randomised controlled trial. The Lancet. 1984; 323(8388):1197-200.
- Höeg Dembrower KE, von Heijne A, Laska AC, Laurencikas E. Patients with aphasia and an infarct in Wernicke's area benefit from early intensive speech and language therapy. Aphasiology. 2017; 31(1):122-8.
- Bowen A, Hesketh A, Patchick E, Young A, Davies L, Vail A, Long A, Watkins C, Wilkinson M, Pearl G, Ralph ML. Clinical effectiveness, cost-effectiveness and service users' perceptions of early, well-resourced communication therapy following a stroke: a randomised controlled trial (the ACT NoW Study). InNIHR Health Technology Assessment programme: Executive Summaries 2012. NIHR Journals Library.

Intensity of SLT on Aphasia

Conclusions

1. ***Moderate intensity language therapy may not be more effective in treating aphasia when compared to less intensive therapy; however, the benefit of high intensity language therapy in those that can tolerate it is not yet known.***

Key Study for Intensity of Language Therapy

- Bakheit AM, Shaw S, Barrett L, Wood J, Carrington S, Griffiths S, Searle K, Koutsi F. A prospective, randomized, parallel group, controlled study of the effect of intensity of speech and language therapy on early recovery from poststroke aphasia. Clinical Rehabilitation. 2007; 21(10):885-94.

Word-Retrieval Interventions

	Discourse	Naming	Verbal Fluency	Social Commun-ication	Repet-ition	Writing	General Compre-hension	Reading Compre-hension	Auditory Compre-hension	Global Speech & Language	ADLs
Lexical Retrieval therapy	1b 1 RCT ✗	1a 2 RCTs ↻	1b 1 RCT ✗	1a 1 RCT ✗	1a 1 RCT ✗	1b 1 RCT ✓	1b 1 RCT ✗	1b 1 RCT ✗	1a 2 RCTs ✗	1a 2 RCTs ✗	1b 1 RCT ✗

Conclusions

1. ***Lexical (word) retrieval therapy may not be beneficial for improving aphasia related outcomes post-stroke.***

Key Study of Word Retrieval

- Nouwens F, de Lau LM, Visch-Brink EG, Van de Sandt-Koenderman WM, Lingsma HF, Goosen S, Blom DM, Koudstaal PJ, Dippel DW. Efficacy of early cognitive-linguistic treatment for aphasia due to stroke: a randomised controlled trial (Rotterdam Aphasia Therapy Study-3). European Stroke Journal. 2017; 2(2):126-36.

Trained Volunteers in Aphasia Training

Intervention	Discourse	Global Speech & Language
Volunteer Facilitated Speech and Language Therapy	2 1 RCT ✗	1b 3 RCTs ✗

Conclusions

1. ***Volunteer facilitated speech and language therapy may not be more beneficial than speech language pathology delivered therapy for improving aphasia related outcomes post-stroke.***
2. ***Volunteers can provide an effective adjunct to speech-language pathologists' treatment.***

Key Studies for Volunteers in Speech and Language Therapy

- Marshall RC, Wertz RT, Weiss DG, Aten JL, Brookshire RH, Garcia-Bunuel L, Holland AL, Kurtzke JF, LaPointe LL, Milianti FJ. Home treatment for aphasic patients by trained nonprofessionals. J Speech Hear Disord 1989; 54:462-470.
- David R, Enderby P, Bainton D. Treatment of acquired aphasia: speech therapists and volunteers compared. Journal of Neurology, Neurosurgery & Psychiatry. 1982; 45(11):957-61.

Group Therapy for Aphasia Post-Stroke

Intervention	Discourse	Naming	Social Communication	Auditory Comprehension	Global Speech & Language
Social Interaction	1b 1 RCT ✕	1b 1 RCT ✕	1b 1 RCT ✕	1b 1 RCT ✕	1b 3 RCTs ✕

Conclusion

1. ***Group therapies may not be more beneficial than individual therapies for improving aphasia related outcomes post-stroke.***
2. ***There is mixed evidence that group therapies offer more benefit than recreational social activities.***

Key Study for Group Therapy

- Wertz RT, Collins MJ, Weiss D, Kurtzke JF, Friden T, Brookshire RH, Pierce J, Holtzapple P, Hubbard DJ, Porch BE, West JA, Davis L, Matovitch V, Morley GK, Resurreccion E. Veterans Administration cooperative study on aphasia: a comparison of individual and group treatment. J Speech Hear Res 1981; 24:580-585.

Training Conversation / Communication Partners

Conclusion

1. ***Training communication partners may result in improved participation in conversation and improved conversational skills of persons with aphasia and their communication partners***

Key Study for Training Communication Partners

- Kagan A, Black SE, Duchan JF, Simmons-Mackie N, Square P. Training volunteers as conversation partners using "supported conversation for adults with aphasia" (SCA): A controlled trial. Journal of Speech, Language and Hearing Research 2001; 44:624-637.

Computer-Based Treatment

Intervention	Discourse	Verbal Fluency	Repetition	Writing	General Comprehension	Reading Comprehension	Auditory Comprehension	Global Speech & Language
Computer based therapies	1b 2 RCTs ⟳	2 1 RCT ⟳	1b 2 RCTs ✓	2 1 RCT ✕	2 1 RCT ⟳	2 1 RCT ✕	2 1 RCT ✕	1b 1 RCT ✕

Conclusion

1. ***The literature is mixed regarding computer-based therapies ability to improve naming.***
2. ***Computer-based therapy may be beneficial for repetition.***

Key Studies for Computer-Based Language and Speech Therapy

- Katz RC, Wertz RT. The efficacy of computer provided reading treatment for chronic aphasic adults. Journal of Speech, Language and Hearing Research 1997; 40:493-507.
- Varley R, Cowell PE, Dyson L, Inglis L, Roper A, Whiteside SP. Self-administered computer therapy for apraxia of speech: two-period randomized control trial with crossover. Stroke. 2016; 47(3):822-8.

Telerehabilitation and Speech Language Therapy

Conclusions

1. ***Remote assessment of language following stroke may be as effective as face-to-face assessment of stroke outcomes among individuals with aphasia.***
2. ***Remotely administered language therapy may be an effective alternative to face-to-face therapy.***

Music-Based Speech Language Therapy

Intervention	Discourse	Naming	Verbal Fluency	Social Commun-ication	Repet-ition	Auditory Compre-hension	Global Speech & Language	Apraxia
Music therapy	1b 2 RCTs ✗	1b 2 RCTs ✗	1a 3 RCTs ✓	1a 2 RCTs ✗	1b 1 RCT ✓	2 1 RCT ✗	1b 2 RCTs ✗	1b 1 RCT ✗

<u>Conclusion</u>

1. ***Music-based speech language therapies, such as melodic intonation therapy may be beneficial in improving verbal fluency, but not social communication, discourse, or global speech and language.***
2. ***There is limited evidence which suggests it may be no better than standard language therapy.***

Key Studies for Music Based Speech Language Therapies

- van der Meulen I, van de Sandt-Koenderman WME, Heijenbrok-Kal MH, Visch-Brink EG, Ribbers GM. The efficacy and timing of melodic intonation therapy in subacute aphasia. Neurorehabilitation and Neural Repair 2014; 28:536-544.
- Conklyn D, Novak E, Boissy A, Bethoux F, Chemali K. The effects of modified melodic intonation therapy on nonfluent aphasia: A pilot study. Journal of Speech, Language, and Hearing Research. 2012.

Constraint-Induced (CI) Aphasia Therapy

Intervention	Discourse	Naming	Social Communication	Repetition	Writing	General Comprehension	Auditory Comprehension	Global Speech & Language
Constraint Induced Aphasia Therapy	1b 1 RCT ✗	1a 3 RCTs ✗	1a 3 RCTs ✗	1b 1 RCT ✓	1b 1 RCT ✓	1b 1 RCT ✗	1a 2 RCTs ↻	1a 4 RCTs ✗

Conclusions

1. ***Constraint induced aphasia therapy may be beneficial for improving repetition and writing.***
2. ***Constraint induced aphasia therapy may not be beneficial for improving global speech and language and social communication.***
3. ***The literature is mixed concerning constraint induced aphasia therapy's ability to improve auditory comprehension.***
4. ***Evidence for the effectiveness of constraint-induced aphasia therapy on language function and everyday communication in individuals with chronic aphasia suggests that it may be as effective as conventional aphasia therapy.***

Key Study for Constraint-Induced Aphasia Therapy

- Sickert A, Anders LC, Münte TF, Sailer M. Constraint-induced aphasia therapy following sub-acute stroke: a single-blind, randomised clinical trial of a modified therapy schedule. Journal of Neurology, Neurosurgery & Psychiatry. 2014; 85(1):51-5.

Repetitive Transcranial Magnetic Stimulation (rTMS)

Intervention	Discourse	Naming	Verbal Fluency	Social Communication	Repetition	General Comprehension	Auditory Comprehension	Global Speech & Language	ADLs
Low Frequency rTMS	1a 3 RCTs ✓	1a 7 RCTs ✓	1a 3 RCTs ✓	1a 3 RCTs ✓	1a 5 RCTs ↻	1b 1 RCT ✗	1a 3 RCTs ↻	1a 7 RCTs ✓	1b 1 RCT ✗

Conclusion

1. ***Inhibitory rTMS may be beneficial for improving discourse, naming, verbal fluency, social communication and global speech and language.***

Key Study for rTMS in Aphasia

- Tsai PY, Wang CP, Ko JS, Chung YM, Chang YW, Wang JX. The persistent and broadly modulating effect of inhibitory rTMS in nonfluent aphasic patients: a sham-controlled, double-blind study. Neurorehabilitation and neural repair. 2014; 28(8):779-87.

Transcranial Direct Current Stimulation

Intervention	Discourse	Naming	Verbal Fluency	Social Communication	Repetition	General Comprehension	Global Speech & Language
tDCS	✓	1a 5 RCTs ✗	1b 1 RCT ✗	1b 1 RCT ✗	1b 1 RCT ✗	1b 1 RCT ✗	1b 1 RCT ✗

Conclusions

1. ***Excitatory tDCS may not be beneficial for improving naming post-stroke.***
2. ***The addition of tDCS to traditional aphasia therapies may improve remediation of language deficits other than naming.***
3. ***Further research is needed to fully understand the current conflicting results of tDCS compared to sham-tDCS treatment.***

Key Studies for tDCS in Aphasia

- Spielmann K, van de Sandt-Koenderman WM, Heijenbrok-Kal MH, Ribbers GM. Transcranial direct current stimulation does not improve language outcome in subacute poststroke aphasia. Stroke. 2018; 49(4):1018-20.
- Polanowska KE, Leśniak M, Seniów JB, Członkowska A. No effects of anodal transcranial direct stimulation on language abilities in early rehabilitation of post-stroke aphasic patients. Neurologia i neurochirurgia polska. 2013; 47(5):414-22.

Drug Therapy for Post-Stroke Aphasia

Piracetam

Interventions	Discourse	Naming	Social Communication	Repetition	Writing	General Comprehension	Auditory Comprehension	Global Speech & Language	ADLs
Piracetam	1b 1 RCT ✗	1a 2 RCTs ✗	1b 1 RCT ✗	1b 1 RCT ✗	1a 2 RCTs ↻	1a 2 RCTs ✗	1a 2 RCTs ✗	1a 2 RCTs ↻	1b 1 RCT ✗

Conclusion

1. ***Piracetam may not be beneficial for improving aphasia related outcomes post-stroke.***

Key Study for Piracetam and Aphasia

- Enderby P, Broeckx J, Hospers W, Schildermans F, Deberdt W. Effect of piracetam on recovery and rehabilitation after stroke: a double-blind, placebo-controlled study. Clinical neuropharmacology. 1994; 17(4):320-31.

Bromocriptine and Levodopa

Interventions	Discourse	Naming	Social Communication	Repetition	General Comprehension	Auditory Comprehension	Global Speech & Language
Bromocriptine or Levodopa	1a 2 RCTs ✗	1a 5 RCTs ✗	2 1 RCT ✗	1b 1 RCT ✓	1b 1 RCT ✗	1b 1 RCT ✗	1a 2 RCTs ✗

Conclusion

1. ***Bromocriptine does not appear to be better than placebo in improving aphasia disorders.***
2. ***There appears to be little effectiveness of levodopa as an adjunct to speech and language therapy.***

Key Studies of Bromocriptine and Levodopa as Adjunct to Aphaisa Therapy

- Ashtary F, Janghorbani M, Chitsaz A, Reisi M, Bahrami A. A randomized, double-blind trial of bromocriptine efficacy in nonfluent aphasia after stroke. Neurology. 2006; 66(6):914-6.
- Seniów J, Litwin M, Litwin T, Leśniak M, Członkowska A. New approach to the rehabilitation of post-stroke focal cognitive syndrome: Effect of levodopa combined with speech and language therapy on functional recovery from aphasia. Journal of the neurological sciences. 2009; 283(1-2):214-8.

Amphetamines

Intervention	Global Speech & Language
Amphetamines	1a 2 RCTs ✓

Conclusion

1. ***Dextroamphetamine appears to improve aphasia recovery when combined with language therapy based on 2 small RCTs.***

Key Study for Dextroamphetamine and Aphasia

- Walker-Batson D, Curtis S, Natarajan R, Ford J, Dronkers N, Salmeron E, Lai J, Unwin DH. A double-blind, placebo-controlled study of the use of amphetamine in the treatment of aphasia. STROKE-DALLAS-. 2001 Sep 1;32(9):2093-6.

Donepezil

Intervention	Discourse	Social Communication	Repetition	General Comprehension	Auditory Comprehension	Global Speech & Language
Donepezil	1b 1 RCT ✓	1b 1 RCT ✗	1b 1 RCT ✗	1b 1 RCT ✗	1b 1 RCT ✗	1b 1 RCT ✓

Conclusions

1. ***Acetylcholinesterase inhibitors may be beneficial for improving naming, but not social communication, repetition, general and auditory comprehension, and global speech and language.***

Key Study for Donepezil in Aphasia

- Berthier ML, Green C, Higueras C, Fernandez I, Hinojosa J, Martín MC. A randomized, placebo-controlled study of donepezil in poststroke aphasia. Neurology. 2006; 67(9):1687-9.

Memantine

Intervention	Discourse	Naming	Social Communication	Repetition	Auditory Comprehension	Global Speech & Language
Memantine	1b 1 RCT ✓	1b 1 RCT ✓	1b 1 RCT ✓	1b 1 RCT ✗	1b 1 RCT ✓	1b 1 RCT ✓

Conclusion

1. ***Memantine may be beneficial for improving discourse, naming, social communication auditory comprehension and global speech and language, but not repetition.***

Key Studies of Memantine in Aphasia Therapy

- Barbancho MA, Berthier ML, Navas-Sánchez P, Dávila G, Green-Heredia C, García-Alberca JM, Ruiz-Cruces R, López-González MV, Dawid-Milner MS, Pulvermüller F, Lara JP. Bilateral brain reorganization with memantine and constraint-induced aphasia therapy in chronic post-stroke aphasia: An ERP study. Brain and language. 2015 ;145:1-0.
- Berthier ML, Green C, Lara JP, Higueras C, Barbancho MA, Dávila G, Pulvermüller F. Memantine and constraint-induced aphasia therapy in chronic poststroke aphasia. Annals of Neurology: Official Journal of the American Neurological Association and the Child Neurology Society. 2009; 65(5):577-85.

Cognitive Rehabilitation for Apraxia

Apraxia Therapy

Interventions	General Comprehension 	Apraxia 	ADLs 
Apraxia Training	**2** **1 RCT** ✓	**2** **1 RCT** ✓	**1a** **2 RCTs** ✓

Conclusions

1. ***Apraxia strategy training may be beneficial for improving activities of daily living.***
2. ***Gesture training for apraxia may be beneficial for improving general comprehension, apraxia and activities of daily living***.

Key Studies for Apraxia Treatment

- Donkervoort M, Dekker J, Stehmann-Saris FC, Deelman BG. Efficacy of strategy training in left hemisphere stroke patients with apraxia: A randomized clinical trial. Neuropsychological Rehabilitation 2001; 11(5):549-566.
- Geusgens C, van Heugten C, Donkervoort M, van den Ende E, Jolles J, van den Heuvel W. Transfer of training effects in stroke patients with apraxia: an exploratory study. Neuropsychological rehabilitation. 2006; 16(2):213-29.

5. Medical Complications Post-Stroke

(Evidence Reviews Chapters 15-17 and Clinician's Handbook Chapter 6)

5a. Dysphagia and Aspiration

Dysphagia Post-Stroke

Conclusions

1. ***Dysphagia is characterized by reduced coordination of oropharyngeal muscles potentially due to a reduction of cortical connectivity which may have a negative impact on factors of pulmonary function.***
2. ***Oral weakness of the facial, palatal and pharyngeal muscles can contribute to dysphagic symptomology.***

Aspiration Post-Stroke

Conclusions

1. ***The incidence of aspiration in the acute phase of stroke varies from 16% to 52%.***
2. ***Silent aspiration occurs in 8% to 27% of acute stroke patients. Of identified aspirators, 20% to 67% developed silent aspiration.***
3. ***Factors indicative of the development of aspiration include: a delayed swallow reflex, reduced peristalsis, respiratory tract infection, abnormal volitional coughing and cough with swallow, dysphonia, soft palate dysfunction, and facial hypesthesia.***
4. ***Tested factors that may not be predictive of aspiration include: poor oral motility and bedside evaluations (which were associated with the identification of non-aspirators).***
5. ***While silent aspiration shows a lower incidence among acute stroke patients than aspiration, both are prevalent and reliably identified.***

Pneumonia Post-Stroke

Conclusion

1. ***Stroke severity, level of consciousness, age, oral hygiene and other factors contributing to the aspiration of bacterial laden secretions and refluxed material are major indicators for increased risk of pneumonia.***

Dysphagia and Nutritional Outcome Measures

Category	Rationale	Individual Assessment Tools
Pharyngeal Phase	Assessed aspects of the pharyngeal phase of swallowing.	• Duration of Stage Transition • Incidence of Aspiration • Pharyngeal Transit Time (PTT)
Esophageal Phase	Assessed aspects of the esophageal phase of swallowing.	• Cricopharyngeal Opening Duration •
Oral Phase	Assessed aspects of the oral phase of swallowing.	• Oral Transit Time (OTT) • Tongue Strength (Overall)
Dysphagia Evaluation	Assessed global tests of swallowing function, oral hygiene and eating behaviours in dysphagic individuals.	• Dysphagia Severity Rating Scale (DSRS) • Mann Assessment of Swallowing Ability • Functional Oral Intake Scale (FOIS) • Standardized Swallowing Assessment (SSA) • Videofluroscopic Swallowing Study (VFSS) • Kubota Water Swallow Test •
Respiratory Infections	Assessed respiratory sequelae of dysphagia including aspiration and pneumonia.	• Pneumonia Incidence and Frequency
Lipid Consumption	Related to triglyceride body composition.	• Triglyceride levels • Cholesterol and Total Cholesterol levels • High Density Lipoprotein (HDL) • Low Density Lipoprotein (LDL)
Calorie Consumption	Assessed caloric intake and fluid intake.	• Proportion of Prescribed Feed Delivered • Total Fluid Intake • Caloric Intake
Protein and Carbohydrate Consumption	Amount of protein and carbohydrates consumed, usually daily.	• Protein Intake • Carbohydrate Intake • Carbohydrate-Protein Ratio
Vitamin and Mineral Consumption	Assessed the consumption of vitamin or minerals.	• Calorie-Nitrogen Deficit • 25-Hydroxyvitamin D Levels • Iron Intake
Body Composition	Different anthropometric measurements.	• Biceps Skinfold Thickness • Body Mass Index (BMI) • Mid-Arm Muscle Circumference (MUAC) • Triceps Skinfold Thickness • Waist Circumference • Weight Gain
Blood Glucose Management		• Fasting Glucose Level • Glucose Tolerance Test
Plasma Proteins	Deal with circulating protein levels in a participant's blood.	• Albumin Levels • Pre-Albumin • Transferrin • Hemoglobin
Blood Pressure	Measures of blood pressure.	• Systolic Blood Pressure • Diastolic Blood Pressure
Lymphocyte Count	Measure of neutrophil to lymphocyte concentrations	• Neutrophil-Lymphocyte Ratio

Activities of Daily Living	Assessed performance and level of independence in various everyday tasks.	• Barthel Index (BI) • Functional Independence Measure (FIM)
Stroke Severity	Assessed the severity of one's stroke through a global assessment of a multitude of deficits a stroke survivor may experience.	• Canadian Neurological Scale (CNS) • Modified Rankin Scale (mRS) • National Institutes of Health Stroke Scale (NIHSS) • European Stroke Scale (ESS)

Management of Dysphagia and Aspiration Post-Stroke

Diagnosis of Dysphagia and Aspiration

Conclusions

1. ***There are a variety of clinical screening tests for determining dysphagia following stroke.***
2. ***There was a wide range of sensitivity (68-97%) and specificity (53-86%) values for the different bedside clinical examinations.***
3. ***There is a wide range in the validity and clinical usefulness of bedside clinical examinations.***
4. ***There was a wide range of sensitivity (first-step=71.4-100%; second-step=13-76.4%) and specificity (first-step=38-100%; second-step=70.3-100%) values for the swallowing provocation test.***
5. ***There is a wide range in the validity and clinical usefulness of the water swallowing test and the swallowing provocation test.***
6. ***Combination of the Water Swallowing Test and oxygen desaturation test may result in an improvement in the predictive accuracy of detecting aspiration and pneumonia over either of these screening tests conducted alone.***
7. ***There is no ideal or defined volume of water that is used to assess dysphagia on the water swallowing test.***
8. ***There is moderate evidence but widespread clinical acknowledgement that the introduction of swallow screening may reduce the incidence of pneumonia among patients with dysphagia when compared to no screening protocol or usual care.***

Dysphagia Imaging Studies in Stroke

Videofluoroscopic Modified Barium Swallow (VMBS) Studies

Conclusions

1. ***Videofluoroscopic Modified Barium Swallow (VMBS) studies are considered the gold standard for dysphagia/aspiration diagnosis.***
2. ***Further research is required to determine conclusively when a VMBS study should be administered or re-adminstered.***
3. ***There is limited evidence that videofluoroscopic (VFS) results may be associated with swallowing function.***

Fiberoptic Endoscopic Evaluation of Swallowing (FEES)

Conclusions

1. ***There is conflicting moderate evidence regarding the reported incidence of pneumonia after flexible endoscopic evaluation of swallowing (FEES) is used versus facial oral tract therapy or videofluoroscopy.***
2. ***There is limited evidence indicating that the incidence of pneumonia may be reduced when dysphagic patients are assessed with FEES versus no assessment. Additionally, FEES may be responsible for a higher proportion of patients treated with instrumental assessment and on standard diet at discharge which may be related to longer periods of non-oral feeding.***
3. ***Flexible endoscopic evaluation of swallowing may reduce the incidence of pneumonia and improve other important factors associated with dysphagia recovery; however, the evidence is limited and further research is required.***

Management of Dysphagia

Swallow Treatment Programs

Conclusion

1. ***Expiratory muscle training may be beneficial for improving the pharyngeal phase, but there is conflicting evidence for its ability to improve a dysphagia evaluation.***

Key Study for Swallow Treatment Programs

- Carnaby G, Hankey GJ, Pizzi J. Behavioural intervention for dysphagia in acute stroke: a randomised controlled trial. *Lancet Neurol. (2006);5:31-37.*

Dietary Modifications

Conclusion

1. ***There is conflicting evidence on the efficacy of dietary modifications to improve the pharyngeal phase, or respiratory infections.***

Key Study on Dietary Modifications

- Diniz PB, Vanin G, Xavier R, Parente MA. Reduced incidence of aspiration with spoon-thick consistency in stroke patients. *Nutr.Clin Pract. (2009);24:414-418.*

Low-Risk Feeding Strategies

Conclusions

1. ***It is important to encourage stroke survivors to feed themselves as the risk of aspiration pneumonia increases 20-fold when they are fed by someone else, generally because they are encouraged to eat at a faster rate.***
2. ***Feed with hand-over-hand support at eye level if necessary.***
3. ***Postural feeding strategies include chin tuck, head tilt, etc***

Compensatory Strategies

Thermal Stimulation

Conclusion

1. ***Thermal stimulation with NMES may be more beneficial than thermal stimulation alone for improving the pharyngeal phase, and dysphagia evaluations.***

Key Study on Thermal Stimulation

- Li W, Kang X, Ren J, Lai X, Tai L. Effects of extended in-patient treatment training on outcome of post-stroke dysphagia. *Eur Rev Med Pharmacol Sci (2017);12713.*

Transcutaneous Electrical Stimulation (TENS)

Conclusions

1. ***Suprahyoid, or suprahyoid with infrahyoid NMES may be beneficial for improving the pharyngeal phase, oral phase and dysphagia evaluations.***
2. ***Infrahyoid NMES alone may not be beneficial for improving dysphagia related outcomes.***

Key Studies on TENS in Dysphagia

- Konecny P, Elfmark M. Electrical stimulation of hyoid muscles in post-stroke dysphagia. Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub (2018);162:40-42.
- Zhang M, Tao T, Zhang ZB, Zhu X, Fan WG, Pu LJ, . . . Yue SW. Effectiveness of Neuromuscular Electrical Stimulation on Patients With Dysphagia With Medullary Infarction. Arch Phys Med Rehabil (2016);97:355-62.
- Xia W, Zheng C, Lei Q, Tang Z, Hua Q, Zhang Y, Zhu S. Treatment of post-stroke dysphagia by vitalstim therapy coupled with conventional swallowing training. J.Huazhong.Univ Sci.Technolog.Med.Sci. (2011);31:73-76.

Repetitive Transcranial Magnetic Stimulation

Conclusions

1. ***The literature is mixed concerning the efficacy of high frequency rTMS for dysphagia and activities of daily living.***
2. ***Bilateral rTMS may lead to greater improvements in dysphagia than unilateral rTMS.***

Key Study on rTMS

- Du J, Yang F, Liu L, Hu J, Cai B, Liu W, . . . Liu X. Repetitive transcranial magnetic stimulation for rehabilitation of poststroke dysphagia: A randomized, double-blind clinical trial. Clin Neurophysiol (2016);127:1907-13.

Transcranial Direct Current Stimulation (tDCS)

Conclusion

1. ***Contralesional anodal tDCS may be beneficial for improving dysphagia evaluations, but not respiratory infections.***

Key Study on tDCS

- Suntrup-Krueger S, Ringmaier C, Muhle P, Wollbrink A, Kemmling A, Hanning U, . . . Pantev C. Randomized trial of transcranial direct current stimulation for poststroke dysphagia. *Annals of neurology (2018);83:328-340.*

Feeding Tubes

Conclusion

1. ***Gastrostomy tube feeding may be more beneficial than nasogastric tubes for improving body composition and calorie consumption but not respiratory infections.***

Key Studies on Feeding Tubes

- Zheng T, Zhu X, Liang H, Huang H, Yang J, Wang S. Impact of early enteral nutrition on short term prognosis after acute stroke. *Journal of Clinical Neuroscience (2015);22:1473-1476.*

- Dennis MS, Lewis SC, Warlow C. Effect of timing and method of enteral tube feeding for dysphagic stroke patients (FOOD): a multicentre randomised controlled trial. *Lancet (2005);365:764-772.*

5b. Nutrition Post-Stroke

Malnutrition in Stroke

Conclusions

1. ***The prevalence of malnutrition varies from 6 - 62% post stroke, depending on timing of assessment and criteria used to define malnutrition.***
2. ***There is currently no "gold standard" for the assessment of nutritional status***

5c. Venous Thromboembolism Post Stroke

Treatment of Venous Thromboembolism

LMW Heparin in Acute Stroke Patients

Conclusions

1. ***It is unclear whether low molecular weight heparin and unfractionated heparin are effective in preventing venous thromboembolism post stroke, without an increased risk of bleeding complications.***
2. ***However, the efficacy of these medications has been demonstrated in non-stroke populations.***
3. ***LMW Heparin agents would offer patients a safe and simple treatment alternative to vitamin K antagonist like warfarin, with no need for regular laboratory monitoring and a similar risk of bleeding.***

Key Studies for LMW Heparin in Acute Stroke Patients

- TOAST investigators. Low molecular weight heparinoid, ORG 10172 (danaparoid), and outcome after acute ischemic stroke: a randomized controlled trial. The Publications Committee for the Trial of ORG 10172 in Acute Stroke Treatment (TOAST) Investigators. *JAMA. (1998);279:1265-1272.*
- Sherman DG, Albers GW, Bladin C, Fieschi C, Gabbai AA, Kase CS, . . . Pineo GF. The efficacy and safety of enoxaparin versus unfractionated heparin for the prevention of venous thromboembolism after acute ischaemic stroke (PREVAIL Study): an open-label randomised comparison. *Lancet (2007);369:1347-1355.*
- Sandercock P, Counsell C, Tseng MC. Low-molecular-weight heparins or heparinoids versus standard unfractionated heparin for acute ischemic stroke. Cochrane Database Syst Rev. 2008 Jul 16; (3): CD000119.
- Schulman S et al. for the RE-COVER study group. Dabigatran versus Warfarin in the Treatment of Acute Venous Thromboembolism. New England Journal of Medicine. 2009 Dec 361; 2342-2352. NEJMoa0906598.
- Bauersachs R, Berkowitz SD, Brenner B, Buller HR, Decousus H, Gallus AS, . . . Schellong S. Oral rivaroxaban for symptomatic venous thromboembolism. *N Engl J Med (2010);363:2499-2510.*
- EINSTEIN Investigators. Oral rivaroxaban for symptomatic venous thromboembolism. *The New England Journal of Medicine (2010);363:2499-2510.*

Mechanical Treatments for Deep Venous Thrombosis

Conclusions

1. ***The literature is mixed regarding the efficacy of intermittent pneumatic compression and graded compression stockings as an effective prophylactic intervention for deep vein thrombosis.***
2. ***There is strong evidence that graduated compression stockings do not reduce the risk of DVT.***
3. ***There is strong evidence that thigh length compression stockings reduce the risk of DVT when compared to below knee stockings.***
4. ***There is strong evidence that intermittent pneumatic compression (IPC) reduces the risk of DVT when compared to no treatment with IPC.***
5. ***There is moderate evidence heparin equivalent to both pneumatic compression and electrical stimulation in reducing risk of DVTs.***

Key Studies for Mechanical Treatments for Deep Venous Thrombosis

- Muir KW, Watt A, Baxter G, Grosset DG, Lees KR. Randomized trial of graded compression stockings for prevention of deep-vein thrombosis after acute stroke. QJM. (2000);93:359-364.
- CLOTS Trials Collaboration. (2009). Effectiveness of thigh-length graduated compression stockings to reduce the risk of deep vein thrombosis after stroke (CLOTS trial 1): a multicentre, randomised controlled trial. The Lancet, 373(9679), 1958-1965.
- CLOTS (Clots in Legs Or sTockings after Stroke) Trial Collaboration. (2010). Thigh-length versus below-knee stockings for deep venous thrombosis prophylaxis after stroke: a randomized trial. Annals of Internal Medicine, 153(9), 553.
- CLOTS Trials Collaboration, Dennis, M., Sandercock, P., Reid, J., Graham, C., Murray, G., ... & Bowler, G. (2013). The effect of graduated compression stockings on long-term outcomes after stroke: the CLOTS trials 1 and 2. Stroke, 44(4), 1075-1079.
- CLOTS (Clots in Legs Or sTockings after Stroke) Trials Collaboration. (2013). Effectiveness of intermittent pneumatic compression in reduction of risk of deep vein thrombosis in patients who have had a stroke (CLOTS 3): a multicentre randomised controlled trial. The Lancet, 382(9891), 516-524.

5d. Post-Stroke Seizures

Conclusions

1. ***Post-stroke seizures not a common complication post stroke, although the rates vary widely across studies and stroke onset.***
2. ***Common risk factors for post-stoke seizures include cortical strokes, severe strokes, greater disability, and younger age.***
3. ***The majority of seizures post stroke are simple partial seizures.***
4. ***Post-stroke seizures appear to be more common in hemorrhagic and cortical strokes, although this may be more directly related to stroke severity rather than etiology or location.***

Key Study on Post Stroke Seizures

- Black S, Norris J, Hachinski V. Post-stroke seizures. *Stroke 1983; 14:134.*

Prevention of Post-Stroke Seizures

Conclusions

1. ***There is no evidence that prophylactic anticonvulsive treatment is beneficial post stroke.***

2. ***Treating all stroke patients with anticonvulsants as primary seizure prophylaxis is not recommended.***

Key Study for Prevention of Post Stroke Seizure

- Gilad R, Boaz M, Dabby R, Sadeh M, Lampl Y. Are post intracerebral hemorrhage seizures prevented by anti-epileptic treatment? *Epilepsy Res. (2011);95:227-231.*

Treatment of Post-Stroke Seizures

Conclusions

1. ***Insufficient evidence exists to guide selection of monotherapy for antiepileptic medications in patients with post-stroke seizures.***
2. ***There is Level 1b and Level 2 evidence that lamotrigine, gabapentin, and carbamazepine are similar in reducing the rate of recurrent post-stroke seizures, but carbamazepine is more poorly tolerated.***
3. ***Decisions to initiate antiepileptic therapy should be tailored to patients' individual needs.***

Key Studies for the Treatment of Post Stroke Seizures

- Gilad R, Sadeh M, Rapoport A, Dabby R, Boaz M, Lampl Y. Monotherapy of lamotrigine versus carbamazepine in patients with poststroke seizure. Clinical Neuropharmacology (2007);30:189-195.
- Rowan AJ, Ramsay RE, Collins JF, Pryor F, Boardman KD, Uthman BM, . . . Tomyanovich ML. New onset geriatric epilepsy: a randomized study of gabapentin, lamotrigine, and carbamazepine. Neurology (2005);64:1868-1873.

5e. Thalamic/Central Pain States Post Stroke (CPSP)

Pathophysiology of Central Post-Stroke Pain

Conclusion

1. ***The precise pathophysiology of central post-stroke pain is unknown, but it appears to be associated with a lesion involving the spino-thalamo-cortical pathway.***

Clinical Features of Central Post-Stroke Pain

Conclusions

1. ***Central-post stroke pain generally involves some form of spontaneous and evoked sensory abnormality on the affected side including dysesthesia, allodynia, and hyperalgesia.***
2. ***Development of central post-stroke pain is most often within the first month of stroke onset.***

Treatment of Central Pain Post Stroke

Amitriptyline

Conclusion

1. ***There is conflicting evidence (based on 2 RCTs) amitriptyline reduces pain post-stroke.***

Key Studies of Amitriptyline to Treat Central Pain Post Stroke

- Leijon G, Boivie J. Central post-stroke pain - a controlled trial of amitriptyline and carbamazepine. Pain (1989);36:27-36.
- Lampl C, Yazdi K, Röper C. Amitriptyline in the prophylaxis of central poststroke pain: preliminary results of 39 patients in a placebo-controlled, long-term study. Stroke (2002);33:3030-3032.

I.V. Lidocaine

Conclusion

1. ***There is moderate evidence (1 RCT) lidocaine results in short-term (45 min) pain relief only.***

Key Study for IV Lidocaine to Treat Central Pain Post Stroke

Attal N, Gaude V, Brasseur L, Dupuy M, Guirimand F, Parker F, Bouhassira D. Intravenous lidocaine in central pain: a double-blind, placebo-controlled, psychophysical study. Neurology (2000);54:564-564.

Anticonvulsants

Conclusions

1. ***Lamotrigine and Gabapentin have been shown in 1 RCT each to reduce pain***
2. ***Pregabalin have been shown to improve other important mood and quality of life issues but not pain per se***
3. ***Levetiracetam has not been shown to alter pain when compared to placebo.***

Key Studies for Anticonvulsants to Treat Central Pain Post Stroke

- Kim JS, Bashford G, Murphy TK, Martin A, Dror V, Cheung R. Safety and efficacy of pregabalin in patients with central post-stroke pain. Pain (2011);152:1018-1023.
- Serpell MG. Gabapentin in neuropathic pain syndromes: a randomised, double-blind, placebo-controlled trial. Pain (2002);99:557-566.
- Jungehulsing GJ, Israel H, Safar N, Taskin B, Nolte CH, Brunecker P, . . . Villringer A. Levetiracetam in patients with central neuropathic post-stroke pain--a randomized, double-blind, placebo-controlled trial. Eur.J.Neurol. (2013);20:331-337.
- Vestergaard K, Andersen G, Gottrup H, Kristensen B, Jensen TS. Lamotrigine for central poststroke pain: a randomized controlled trial. Neurology (2001);56:184-190.

Narcotics

Conclusions

1. ***There is moderate evidence (1 RCT) high strength u-opioid agonist levorphanol reduces CPSP.***
2. ***There is moderate evidence (1 RCT) I.V. morphine results in analgesia; only a minority may benefit from long-term treatment.***

Key Study for Narcotics in Treatment of Post Stroke Central Pain

- Attal N, Guirimand F, Brasseur L, Gaude V, Chauvin M, Bouhassira D. Effects of IV morphine in central pain: a randomized placebo-controlled study. Neurology (2002);58:554-563.

Mexilitine

Conclusion

1. ***There is limited evidence Mexilitine reduces CPSP.***

Key Study of Mexilitine in Treatment of Post Stroke Central Pain

- Awerbuch GI, Sandyk R. Mexiletine for thalamic pain syndrome. International journal of neuroscience (1990);55:129-133.

Motor Cortex Stimulation

Conclusions

1. ***There is limited evidence that brain stimulation reduces CPSP (motor cortical stimulation> deep brain stimulation > spinal cord stimulation).***
2. ***rTMS may provide benefit for post-stroke pain when compared to sham stimulation.***

Key Studies of Motor Cortex Stimulation and Treatment of Post Stroke Central Pain

- Katayama Y, Fukaya C, Yamamoto T. Poststroke pain control by chronic motor cortex stimulation: neurological characteristics predicting a favorable response. Journal of neurosurgery (1998);89:585-591.
- Lefaucheur JP, Drouot X, Menard-Lefaucheur I, Zerah F, Bendib B, Cesaro P, . . . Nguyen JP. Neurogenic pain relief by repetitive transcranial magnetic cortical stimulation depends on the origin and the site of pain. J.Neurol.Neurosurg.Psychiatry (2004);75:612-616.

Fluvoxamine

Conclusion

1. ***There is limited evidence SSRI fluxoxamine is useful in CPSP relatively early after stroke onset.***

Key Studies for Fluvoxamine and Treatment of Post Stroke Central Pain

- Shimodozono M, Kawahira K, Kamishita T, Ogata A, Tohgo S-I, Tanaka N. Brief clinical report reduction of central poststroke pain with the selective serotonin reuptake inhibitor fluvoxamine. International Journal of Neuroscience (2002);112:1173-1181.

Algorithmic Treatment Approach to Central Post Stroke Pain

Conclusions

1. ***A wide range of pharmacological interventions are available for the treatment of central pain post stroke, including anticonvulsants, antidepressants, anesthetics, and narcotics.***
2. ***The majority of these require further research to determine their effectiveness in pain reduction with Gabapentin, Lamotrigine and perhaps Amitriptyline showing the most promise; narcotics are a treatment of last resort.***
3. ***Repetitive transcranial magnetic stimulation may be effective in reducing central pain post stroke when delivered at higher frequencies, although further research is required.***

5f. Fatigue

Conclusions

1. ***Fatigue is a common condition post stroke, although there is variation in reported rates.***
2. ***Risk factors for post-stroke fatigue include depression, chronic pain, and sleep disorders***
3. ***Fatigue may be associated with poor recovery.***

Treatment of Post-Stroke Fatigue

Modafinil

Conclusion

1. ***The literature is mixed on the use of Modafinil for treating post-stroke fatigue.***

Key Studies of Modafinal for Post Stroke Fatiuge

- Poulsen MB, Damgaard B, Zerahn B, Overgaard K, Rasmussen RS. Modafinil may alleviate poststroke fatigue: a randomized, placebo-controlled, double-blinded trial. Stroke (2015);46:3470-3477.
- Bivard A, Lillicrap T, Krishnamurthy V, Holliday E, Attia J, Pagram H, . . . Levi CR. MIDAS (Modafinil in Debilitating Fatigue After Stroke) A Randomized, Double-Blind, Placebo-Controlled, Cross-Over Trial. Stroke (2017);48:1293-1298.
- Lillicrap TP, Levi CR, Holliday E, Parsons MW, Bivard A. short-and Long-term efficacy of Modafinil at improving Quality of Life in stroke survivors: a Post Hoc sub study of the Modafinil in Debilitating fatigue after stroke trial. Frontiers in neurology (2018);9:269.

Cognitive Therapy/Graded Activity Training

Conclusion

1. ***Limited evidence shows that and cognitive behavioural therapy with graded activity training may be effective treatments for post-stroke fatigue.***

Key Study for Congnitive Behavioural Therapy in Post Stroke Fatigue

- Zedlitz AMEE, Rietveld TCM, Geurts AC, Fasotti L. Cognitive and graded activity training can alleviate persistent fatigue after stroke: A randomized, controlled trial. Stroke (2012);43:1046-1051

6. Depression and Community Reintegration Post-stroke

(Evidence Reviews Chapters 18-19 and Clinician's Handbook Chapter 7)

6a. Depression

Risk Factors for Depression

The most commonly identified risk factors for post stroke depression include:

- Female sex (especially those with severe depression)
- Previous history of depression
- Stroke severity, functional limitations or need for assistance with activities of daily living
- Cognitive impairment
- Social factors (living alone, divorced or living in a nursing home)

Why is Depression Post Stroke Important?

Depression post stroke is important because it is associated with:

- Increased physical impairment and decreased physical recovery.
- Increased cognitive impairment.
- Decrease social participation and quality of life.
- Increased risk for mortality.
- Increased risk of depression for informal caregivers.
- Increase healthcare utilization for both.

Outcome Measures in Post Stroke Depression and Community Reintegration

Category	Rationale	Individual Assessment Tools
Activities of daily living 	These outcome measures assessed performance and level of independence in various everyday tasks.	• Activities of Daily Living Scale • Barthel Index (BI) • Frenchay Activities Index (FAI) • Functional Independence Measure (FIM) • Nottingham Extended Activities of Daily Living • Stroke Impact Scale (activities of daily living)
Anxiety 	These measures assessed the presence and severity of anxiety disorder, and its individual symptoms.	• State-trait Anxiety Inventory • Hospital Anxiety and Depression Scale (HADS)
Balance, Ambulation, Mobility 	These outcome measures assessed motor function, balance, ambulatory abilities and gait.	• 6-Minute Walk Test • Berg Balance Scale • Modified Rivermead Mobility Index (MRMI) • Timed Up & Go Test (TUG)
Caregiver Burden	These outcome measures assess the level of burden for caretakers of stroke survivors.	• Bakas Caregiver Outcome Scale • Zarit Burden Interview

		
Cognition 	These outcome measures assessed an individual's overall cognitive processing capability factoring in multiple domains.	• Mini Mental Status Examination (MMSE) • Montreal Cognitive Assessment (MoCA)
Community Reintegration Social Participation 	These outcome measures assess an individual's ability to reintegrate into their community and social behaviours.	• Reintegration to Normal Living Index (RNLI) • Social Support Inventory for Stroke Survivors (SSIS) • Use of Community/Aids Received
Depression 	These measures assessed the severity and presence of major and/or minor depressive disorder and its individual symptoms.	• Beck Depression Inventory (BDI) • Geriatric Depression Scale (GDS) • Hospital Anxiety and Depression Scale (HADS) • Patient Health Questionnaire (PHQ-9) • Post-Stroke Depression Rating Scale • Stroke Aphasic Depression Questionnaire • Zung Self-Rating Depression Scale
Driving 	These outcome measures assess both motor related skills and cognitive/perceptual skills for driving motor vehicles.	• Adelaide Driving Self-efficacy Scale • Useful Field of View • Visual Scanning Analyzer
Education 	These outcome measures assessed an individual's knowledge of stroke, living with stroke and related information to care services.	• Stroke Care Information Test • Health education impact questionnaire • Stroke Knowledge and Lifestyle Modification Questionnaire
Emotional Lability 	These outcome measures assessed the severity and frequency of emotional volatility and inappropriate emotional responses.	• Emotional Distress Scale • Emotional Incontinence – Kim's Criteria • Stroke Impact Scale (emotion)
Mental Health and Mood CoFactors 	These outcome measures assess psychiatric dysfunction in a number of mental health related dimensions and assessments examining aspects of behavior or personality which relate to, but are not directly equivalent with, mood related outcomes.	• Apathy Scale • Depression, anxiety and stress scale (DASS-21) • Hospital Anxiety and Depression Scale (HADS) • Patient Health Questionnaire (PHQ-9) • State-Trait Anger Expression Inventory • Symptom Checklist 90-item revised
Quality of Life 	These outcome measures assessed an individual's overall quality of life and their perception of it, generally compared to their preinjury status.	• Assessment of Quality of Life Instrument • EuroQol Quality of Life (EQ-5D) • Medical Outcome Trusts' Short Form Health Survey (SF-36 or SF-12) • Sickness Impact Profile • Stroke and Aphasia Quality of Life Scale-39 (SAQOL-39)

Satisfaction with Care 	These outcome measures assessed an individual's satisfaction with various aspects of their care.	• Client Satisfaction Questionnaire • Satisfaction with stroke care questionnaire
Self-Efficacy 	These outcome measures assess an individual's confidence in their own knowledge and abilities, and can relate to both a patient or their caregiver.	• Stroke self-efficacy questionnaire **Caregiver Self-Efficacy** • Caregiver Competence Scale • Preparedness for caregiving scale
Sexuality 	These outcome measures assess sexual function and dysfunction.	• Changes in Sexual Functioning Questionnaire
Stroke Severity 	These outcome measures assessed the severity of one's stroke through a global assessment of a multitude of deficits a stroke survivor may experience.	• Modified Rankin Scale (MRS) • National Institutes of Health Stroke Scale (NIHSS) • Oxford Handicap Scale • Stroke-Adapted Sickness Impact Profile (SA-SIP30)

Drug Therapy for Post-Stroke Depression

Heterocyclic Antidepressants in Post Stroke Depression

Conclusions

1. ***Nortriptyline may be beneficial for improving post-stroke depression.***
2. ***The literature is mixed concerning heterocyclic antidepressants ability to improve activities of daily living***

Key Study for Tricyclic Antidepressants in Post Stroke Depression

- Robinson RG, Schultz SK, Castillo C, Kopel T, Kosier JT, Newman RM, . . . Starkstein SE. Nortriptyline versus fluoxetine in the treatment of depression and in short-term recovery after stroke: A placebo-controlled, double-blind study. Am.J.Psychiatry (2000);157:351-359.

Selective Serotonin Reuptake Inhibitors (SSRIs) in PSD

Conclusions

1. ***Escitalopram or citalopram may be beneficial for improving post-stroke depression, anger, emotional lability and activities of daily living.***
2. ***The literature is mixed concerning the efficacy of fluoxetine for post-stroke depression.***

Key Studies for SSRIs in Post Stroke Depression

- Chollet F, Tardy J, Albucher J-F, Thalamas C, Berard E, Lamy C, . . . Niclot P. Fluoxetine for motor recovery after acute ischaemic stroke (FLAME): a randomised placebo-controlled trial. The Lancet Neurology (2011);10:123-130
- Kim JS, Lee EJ, Chang DI, Park JH, Ahn SH, Cha JK, . . . Choi-Kwon S. Efficacy of early administration of escitalopram on depressive and emotional symptoms and neurological dysfunction after stroke: a multicentre, double-blind, randomised, placebo-controlled study. Lancet Psychiatry (2017);4:33-41.

- Robinson RG, Jorge RE, Moser DJ, Acion L, Solodkin A, Small SL, . . . Arndt S. Escitalopram and problem-solving therapy for prevention of poststroke depression: A randomized controlled trial. Jama (2008);299:2391-2400.
- Andersen G, Vestergaard K, Lauritzen L. Effective treatment of poststroke depression with the selective serotonin reuptake inhibitor citalopram. Stroke (1994);25:1099-1104.
- Choi-Kwon S, Han SW, Kwon SU, Kang DW, Choi JM, Kim JS. Fluoxetine treatment in poststroke depression, emotional incontinence, and anger proneness: A double-blind, placebo-controlled study. Stroke (2006);37:156-161.

Psychostimulants (Amphetamines)

Conclusions

1. ***Methylphenidate (a psychostimulant) may be effective in treating depression post-stroke and has an earlier onset of action than traditional antidepressants.***

Key Study for Methylphenidate in Treatment of Post Stroke Depression

- Grade C, Redford B, Chrostowski J, Toussaint L, Blackwell B. Methylphenidate in early poststroke recovery: A double-blind, placebo-controlled study. Arch.Phys.Med.Rehabil. (1998);79:1047-1050.

Summary of Effectiveness of Anti-Depressants

Drug Class	Example	Effectiveness
Heterocyclic Antidepressants	Nortriptyline	Yes – High side effect profile
Selective Serotonin Reuptake Inhibitors (SSRIs)	Sertraline, Fluoxetine, Celexa	Yes – May also improve neurorecovery (Chollet et al)
Amphetamines	Methylphenidate	Less Certain – Earlier onset

Conclusion

1. ***There is strong evidence that heterocyclic antidepressants and SSRIs improve PSD.***
2. ***Methylphenidate (a psychostimulant) may be effective in treating PSD with earlier onset of action.***

Functional Improvement with Antidepressants

Conclusion

1. ***There is strong evidence that heterocyclic and SSRI antidepressant medications are associated with greater functional recovery and improvement in ADLs.***

Non-Pharmacological Treatments of PSD

Exercise for Depressive Symptoms Post Stroke

Conclusions

1. ***The literature is mixed concerning physical activity interventions for improving depression.***
2. ***Physical activity does not seem to be beneficial for improving anxiety, activities of daily living or quality of life post-stroke.***

Key Studies for Exercise and Depresson

- Topcuoglu A, Gokkaya NK, Ucan H, Karakus D. The effect of upper-extremity aerobic exercise on complex regional pain syndrome type 1: A randomized controlled study on subacute stroke. Top Stroke Rehabil (2015);22:253-61.

- van de Port IG, Wevers LE, Lindeman E, Kwakkel G. Effects of circuit training as alternative to usual physiotherapy after stroke: Randomised controlled trial. BMJ (2012);344:e2672.
- Harrington R, Taylor G, Hollinghurst S, Reed M, Kay H, Wood VA. A community-based exercise and education scheme for stroke survivors: A randomized controlled trial and economic evaluation. Clin Rehabil. (2010);24:3-15.
- Lai SM, Studenski S, Richards L, Perera S, Reker D, Rigler S, Duncan PW. Therapeutic exercise and depressive symptoms after stroke. J.Am.Geriatr.Soc. (2006);54:240-247.

Repetitive Transcranial Magnetic Stimulation

Conclusion

1. ***High frequency rTMS may be beneficial for improving depression and apathy post-stroke, but not activities of daily living.***

Key Study for rTMS in Post Stroke Depression

- Gu SY, Chang MC. The effects of 10-Hz repetitive transcranial magnetic stimulation on depression in chronic stroke patients. Brain stimulation (2017);10:270-274.

Transcranial Direct Current Stimulation

Conclusion

1. ***Dual tDCS could be beneficial for improving post-stroke depression.***

Key Study for tDCS in Post Stroke Depression

- Valiengo LC, Goulart AC, de Oliveira JF, Bensenor IM, Lotufo PA, Brunoni AR. Transcranial direct current stimulation for the treatment of post-stroke depression: results from a randomised, sham-controlled, double-blinded trial. J Neurol Neurosurg Psychiatry (2017);88:170-175.

Cognitive-Behavioural Therapy (CBT) Post-Stroke

Conclusions

1. ***The literature is mixed regarding the effectiveness of CBT for improving post-stroke depression.***
2. ***CBT does not appear improve activities of daily living or quality of life.***

Key Studies on Cognitive Behavioural Therapy and Depression

- Fang Y, Mpofu E, Athanasou J. Reducing depressive or anxiety symptoms in post-stroke patients: Pilot trial of a constructive integrative psychosocial intervention. *Int J Health Sci (Qassim) (2017);11:53-58.*
- Visser MM, Heijenbrok-Kal MH, Van't Spijker A, Lannoo E, Busschbach JJV, Ribbers GM. Problem-solving therapy during outpatient stroke rehabilitation improves coping and health-related quality of life: Randomized controlled trial. *Stroke (2016);47:135-142.*
- Thomas SA, Walker MF, Macniven JA, Haworth H, Lincoln NB. Communication and low mood (calm): A randomized controlled trial of behavioural therapy for stroke patients with aphasia. *Clin Rehabil. (2013);27:398-408.*
- Mitchell PH, Veith RC, Becker KJ, Buzaitis A, Cain KC, Fruin M, . . . Teri L. Brief psychosocial-behavioral intervention with antidepressant reduces poststroke depression significantly more than usual care with antidepressant: Living well with stroke: Randomized, controlled trial. *Stroke (2009);40:3073-3078.*
- Watkins CL, Auton MF, Deans CF, Dickinson HA, Jack CI, Lightbody CE, . . . Leathley MJ. Motivational interviewing early after acute stroke: A randomized, controlled trial. *Stroke (2007)38:1004-1009.*

- Watkins, C. L., Wathan, J. V., Leathley, M. J., Auton, M. F., Deans, C. F., Dickinson, H. A., ... & Lightbody, C. E. (2011). The 12-month effects of early motivational interviewing after acute stroke: a randomized controlled trial. Stroke, 42(7), 1956-1961.

Care Provision and Educational Resources

Conclusions

1. ***Coordinated care and comprehensive follow-up may be beneficial for improving post-stroke depression, but not other mood related outcomes.***
2. ***Goal-setting programs or home visits may not be beneficial for improving mood related outcomes post-stroke.***

Key Studies of Care Provision and Post Stroke Depression'

- Graven C, Brock K, Hill KD, Cotton S, Joubert L. First year after stroke: An integrated approach focusing on participation goals aiming to reduce depressive symptoms. Stroke (2016);47:2820-2827.
- Wong FKY, Yeung SM. Effects of a 4-week transitional care programme for discharged stroke survivors in Hong Kong: A randomised controlled trial. Health & Social Care In The Community (2015);23:619-631.
- Jones F, Gage H, Drummond A, Bhalla A, Grant R, Lennon S, . . . Liston M. Feasibility study of an integrated stroke self-management programme: A cluster-randomised controlled trial. BMJ Open (2016);6.

Art Therapy

Conclusions

1. ***Art therapy may be beneficial for improving depression, activities of daily living and quality of life post-stroke, but not anxiety.***

Key Study in Art Therapy in Treating Post Stroke Depression

- Kongkasuwan R, Voraakhom K, Pisolayabutra P, Maneechai P, Boonin J, Kuptniratsaikul V. Creative art therapy to enhance rehabilitation for stroke patients: A randomized controlled trial. Clinical Rehabilitation (2016);30:1016-1023.

Music Therapy in Depression

Conclusion

1. ***The literature is mixed regarding music therapies efficacy for improving mood related outcomes post-stroke.***

Key Study for Music Therapy in Depression

- Raglio A, Zaliani A, Baiardi P, Bossi D, Sguazzin C, Capodaglio E, . . . Imbriani M. Active music therapy approach for stroke patients in the post-acute rehabilitation. Neurol Sci (2017);38:893-897.

6b. Community Reintegration Post Stroke

Effects of Caregiving Post Stroke

Conclusions

1. ***Commonly identified effects of caregiving on the caregiver include decreased health (both physical and mental), decreased social contact and activity, increased risk for depression, increased carer stress, strain or burden and an overall decrease in quality of life.***
2. ***Decreased social contact and activity in itself may contribute to increased carer strain, increased risk of depression and decreased life satisfaction.***
3. ***Age, severity of stroke, stroke-related impairments, and functional and cognitive status have been reported as influencing caregiver outcomes.***

Patient Education Programs

Conclusion

1. ***Education programs may not benefit patient or caregiver outcomes.***

Key Studies for Patient Education Programs

- Rodgers H, Atkinson C, Bond S, Suddes M, Dobson R, Curless R. Randomized controlled trial of a comprehensive stroke education program for patients and caregivers. Stroke (1999);30:2585-2591.
- Eames S, Hoffmann T, Worrall L, Read S. Delivery styles and formats for different stroke information topics: patient and carer preferences. Patient.Educ.Couns. (2011);84:e18-e23.

Psycho-social and Emotional Support

Conclusion

1. ***There is conflicting evidence about the effect of psychosocial and emotional support programs to improve mental health, activities of daily living, quality of life and optimism.***

Key Studies of Psychosocial Support Post Stroke

- Glass TA, Berkman LF, Hiltunen EF, Furie K, Glymour MM, Fay ME, Ware J. The Families In Recovery From Stroke Trial (FIRST): primary study results. Psychosom.Med. (2004);66:889-897.
- Friedland JF, McColl M. Social support intervention after stroke: results of a randomized trial. Arch.Phys.Med.Rehabil. (1992);73:573-581

Discharge Planning and Active Care Management

Conclusion

1. ***Discharge planning and active care management may not improve patient or caregiver outcomes.***

Key Studies for Discharge Planning Post Stroke

- Saal S, Becker C, Lorenz S, Schubert M, Kuss O, Stang A, . . . Behrens J. Effect of a stroke support service in Germany: A randomized trial. Topics in Stroke Rehabilitation (2015);22:429-436.
- Allen K, Hazelett S, Jarjoura D, Hua K, Wright K, Weinhardt J, Kropp D. A randomized trial testing the superiority of a postdischarge care management model for stroke survivors. J.Stroke Cerebrovasc.Dis. (2009);18:443-452.

- Mayo NE, Nadeau L, Ahmed S, White C, Grad R, Huang A, . . . Wood-Dauphinee S. Bridging the gap: the effectiveness of teaming a stroke coordinator with patient's personal physician on the outcome of stroke. Age Ageing (2008);37:32-38.
- Lincoln NB, Francis VM, Lilley SA, Sharma JC, Summerfield M. Evaluation of a stroke family support organiser: a randomized controlled trial. Stroke (2003);34:116-121.
- Dennis M, O'Rourke S, Slattery J, Staniforth T, Warlow C. Evaluation of a stroke family care worker: results of a randomised controlled trial. BMJ (1997);314:1071-1076.

Self-Management Strategies

Conclusion

1. ***Self management programs may be beneficial for improving self-efficacy.***

Key Studies of Self Management Strategies Post Stroke

- Sit JWH, Chair SY, Choi KC, Chan CWH, Lee DTF, Chan AWK, . . . Taylor-Piliae RE. Do empowered stroke patients perform better at self-management and functional recovery after a stroke? A randomized controlled trial. Clinical Interventions in Aging (2016);11:1441-1450.
- Cadilhac DA, Hoffmann S, Kilkenny M, Lindley R, Lalor E, Osborne RH, Batterbsy M. A phase II multicentered, single-blind, randomized, controlled trial of the stroke self-management program. Stroke (2011);42:1673-1679.

Caregiver Skills Training

Conclusion

1. ***Caregiver training may not have specific benefits to carers.***

Key Studies for Caregiver Sills Training

- Wang TC, Tsai AC, Wang JY, Lin YT, Lin KL, Chen JJ, . . . Lin TC. Caregiver-mediated intervention can improve physical functional recovery of patients with chronic stroke: a randomized controlled trial. Neurorehabil Neural Repair (2015);29:3-12.
- Bakas T, Farran CJ, Austin JK, Given BA, Johnson EA, Williams LS. Content validity and satisfaction with a stroke caregiver intervention program. J.Nurs.Scholarsh. (2009);41:368-375.
- Kalra L, Evans A, Perez I, Melbourn A, Patel A, Knapp M, Donaldson N. Training carers of stroke patients: randomised controlled trial. BMJ (2004);328:1099 .
- Evans RL, Matlock AL, Bishop DS, Stranahan S, Pederson C. Family intervention after stroke: does counseling or education help? Stroke (1988);19:1243-1249.

Conclusions on Community Supports

Conclusions

1. ***Higher levels of social support are associated with greater functional gains, less depression, improved mood and social interaction as well as improved quality of life.***
2. ***Social support is predictive of discharge destination.***
3. ***Interventions to help access community support services is associated with increased social activity.***
4. ***It is important to include the caregiver as well in social support interventions.***

Exercise and Physiotherapy Interventions

Conclusions

1. ***Home exercise programs with picture descriptions may not be beneficial for improving activities of daily living, balance, ambulation and mobility, and self-efficacy.***
2. ***Community walking programs may be beneficial for improving balance, ambulation and mobility as well as community reintegration and social support.***
3. ***For caregivers, client centered support with activities of daily living may not beneficial for improving activities of daily living, balance ambulation and mobility, community reintegration and social support, quality of life and optimism, self-efficacy or caregiver burden.***

Key Study for Exercise and Physiotherapy Interventions

- Bertilsson AS, Eriksson G, Ekstam L, Tham K, Andersson M, von Koch L, Johansson U. A cluster randomized controlled trial of a client-centred, activities of daily living intervention for people with stroke: one year follow-up of caregivers. Clinical Rehabilitation (2016);30:765-75.

Sexuality, Aging, and Disability

Conclusions

1. ***A decrease in sexual activity is very common post-stroke and is likely related to a changed body image, reduced self-esteem and lack of communication with one's partner.***
2. ***There is consensus opinion that sexual issues need to be addressed as an important part of community reintegration.***
3. ***Sexual rehabilitation programs may not be beneficial for improving activities of daily living, mental health, quality of life and optimism and sexual health.***

Key Study for Sexuality Post Stroke

- Sansom J, Ng L, Zhang N, Khan F. Let's talk about sex: A pilot randomised controlled trial of a structured sexual rehabilitation programme in an Australian stroke cohort. International Journal of Therapy and Rehabilitation (2015);22:21-29.

Driving Post-Stroke

Conclusion

1. ***Despite a lack of research, patients for whom there is a concern about their ability to drive post-stroke by law in Ontario need to be reported and properly assessed.***
2. ***Simulator training, useful field of view training or Dynavision training may not be beneficial for improving driving related outcomes.***

Key Studies for Driving Post Stroke

- Akinwuntan AE, De Weerdt W, Feys H, et al. Effect of simulator training on driving after stroke: a randomized controlled trial. Neurology 2005; 65:843-850.
- Devos et al. (2009)
- Mazer BL, Sofer S, Korner-Bitensky N, Gelinas I, Hanley J and Wood-Dauphinee S. Effectiveness of a visual attention retraining program on the driving performance of clients with stroke. Arch Phys Med Rehabil 2003; 84(4):541-550.

Return to Work Post Stroke

Conclusion

1. ***Occupational workplace therapy may not be beneficial for improving activities of daily living, balance, ambulant and mobility, cognition or quality of life and optimism.***

Key Study for Return to Work Post Stroke

- Mazer BL, Sofer S, Korner-Bitensky N, Gelinas I, Hanley J and Wood-Dauphinee S. Effectiveness of a visual attention retraining program on the driving performance of clients with stroke. Arch Phys Med Rehabil 2003; 84(4):541-550.

Leisure/Socialization

Conclusions

1. ***Deterioration in social and leisure activities is common post-stroke and is greatest in women, the young and those who are better educated.***
2. ***Perceptions about how others view their disabilities and perceptions about how they will be able to cope post-stroke may influence the degree of social isolation experienced.***
3. ***Research is limited in this area.***