***Appendix B, search terms***

MEDLINE

((("Nervous System Diseases"[MeSH Terms] OR "neurologic disorder\*"[Text Word] OR "neurological disorder\*"[Text Word] OR "nervous system disorder\*"[Text Word] OR "cerebrovascular disorder\*"[Text Word] OR "motor disorder\*"[Text Word] OR "motor impairment\*"[Text Word] OR "brain injur\*"[Text Word] OR "cerebral pals\*"[Text Word] OR "paralys\*"[Text Word] OR "Paresis"[Text Word] OR "Spastic"[Text Word] OR "Diplegia"[Text Word] OR "ataxi\*"[Text Word] OR "apoplex\*"[Text Word] OR "stroke"[Text Word]) AND ("Feedback"[MeSH Terms] OR "feedback, psychological"[MeSH Terms] OR "Formative Feedback"[MeSH Terms] OR "Virtual Reality"[MeSH Terms] OR "feedback, sensory"[MeSH Terms] OR "reinforcement, psychology"[MeSH Terms] OR "reinforcement, verbal"[MeSH Terms] OR "biofeedback, psychology"[MeSH Terms] OR "Feedback"[Text Word] OR "Augmented feedback"[Text Word] OR "Knowledge of performance"[Text Word] OR "Knowledge of result"[Text Word] OR "Biofeedback"[Text Word] OR "attentional focus"[Text Word] OR "visual feedback"[Text Word] OR "sensory feedback"[Text Word] OR "sensorimotor feedback"[Text Word] OR "audio feedback"[Text Word] OR "proprioceptive feedback"[Text Word] OR "reinforcement learning"[Text Word] OR "punishment\*"[Text Word] OR "reward\*"[Text Word] OR "positive reinforcement\*"[Text Word] OR "negative reinforcement\*"[Text Word] OR "psychological reinforcement\*"[Text Word])) AND ("Psychomotor Performance"[MeSH Terms] OR "Activities of Daily Living"[MeSH Terms] OR "Recovery of Function"[MeSH Terms] OR "Learning"[MeSH Terms] OR "Motor performance"[Text Word] OR "Sensory motor performance"[Text Word] OR "motor skill\*"[Text Word] OR "Motor learning"[Text Word] OR "Task performance"[Text Word] OR "ADL"[Text Word] OR "Motor function"[Text Word])) NOT (("Animals"[Mesh]) NOT "Humans"[Mesh])

**EMBASE**

**Set Search Statement**

1. exp cerebrovascular accident/

2. exp cerebral palsy/

3. Neurologic\* disorder.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

4. exp neurologic disease/

5. Nervous system disorder\*.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word

6. Cerebrovascular disorder\*.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word

7. Motor disorder\*.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

8. Paralys\*.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

9. Paresis.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

10. Spastic.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

11. Diplegia.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

12. Brain injury.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

13. Ataxi\*.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

14. Cerebral pals\*.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

15. Stroke.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

16. Apoplex\*.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

17. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16

18. exp feedback system/

19. exp constructive feedback/

20. exp computer simulation/

21. exp sensory feedback/

22. exp "reinforcement (psychology)"/

23. exp biofeedback/

24. Feedback.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

25. Augmented feedback.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

26. (Knowledge adj2 performance).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

27. (Knowledge adj2 result).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word

28. biofeedback.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

29. attention\* focus.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

30. visual feedback.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

31. sensory feedback.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

32. Sensorimotor feedback.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

33. Audio feedback.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

34. Proprioceptive feedback.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word

35. Reinforcement learning.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

36. Punishment.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

37. Reward.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

38. Positive reinforcement.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

39. Negative reinforcement.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word

40. Psychological reinforcement.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

41. 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40

42. exp psychomotor performance/

43. exp daily life activity/

44. exp convalescence/

45. exp learning/

46. Motor performance.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

47. Motor skill.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

48. motor learning.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

49. performance.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

50. Task performance.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

51. ADL.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

52. Activit\* of daily living.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

53. 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52

54. 17 and 41 and 53

***Appendix C, data extraction template***

|  |  |  |  |
| --- | --- | --- | --- |
| Heading | Subheading |  | Description |
| Source | Covidence ID | Text field |  |
| Author | Text field | Name of the primary author |
| Corresponding author and email | Text field | Name, email |
| Country of origin | Text field | Where the study was performed |
| Conflicts of interest | Text field | Reported conflicts of interest or funding sources associated with the method used |
| Method | Study design | Single choice | RCT; Quazi randomized; Cluster randomized; Randomized cross-over; Cross over; CCT |
| Assessor Blinded | Single choice | Yes; No |
| Participant Blinded | Single choice | Yes; No |
| Number of arms/groups | Single choice | 1; 2; 3; 4 |
| Diagnosis | Multiple choice | Cerebral palsy; Stroke (incl. SAH); Cerebral trauma (SDH) |
| Diagnostic criteria | Text field | Ex. WHO or “no.” |
| Age category | Single choice | Children (mean age 8-12); Teenagers (mean age 13-17); Adults (mean age 18 and above) |
| Motor training category | Multiple choice | Upper extremity; Lower extremity; Balance training; Gait / Treadmill; Activities of daily living |
| Describe motor training | Text field | Ex. Sitting, multidirectional reaching towards targets |
| Setting | Single choice | Hospital, inpatient; Hospital, outpatient; Retirement home; Community center; School; Lab; Homebased |
| Length of total training period | Text field | Whole intervention period (minutes/hours/days/months) |
| Frequency and duration | Text field | x min., x times / pr. week |
| Outcome 1 | Text field | Name of outcome measure. If not named, describe the method. |
| Outcome 2 | Text field | Name of outcome measure. If not named, describe the method. |
| Outcome 3 | Text field | Name of outcome measure. If not named, describe the method. |
| Outcome 4 | Text field | Name of outcome measure. If not named, describe the method. |
| Timing of outcome, category | Multiple choice | Immediate (after or up to 4 hours after one training bout); Short-term (more than 4 hours after or up to two weeks after completion of the intervention period); Long-term (more than two weeks to longest possible follow-up postintervention) |
| Describe the timing of the outcome. | Text field | T1: last training day / T2: 3 month follow up |
| Usual care (motor training) in addition to research intervention? | Single choice | Yes; No |
| Intervention groups 1, 2, 3 (separated in covidence template) | Sample size | Text field | Number of persons |
| % male | Text field | Percentage |
| Time since diagnosis | Text field | Mean (SD) / Median (IQR) |
| Age | Text field | Mean (SD) / Median (IQR) |
| Comorbidities | Text field |  |
| Severity of disability | Text field | Any clinical data from the characteristics table |
| Assistive devices | Text field | No. of people using x device (ex., Wheelchair, walker, cane, TAO) |
| Feedback Characteristics | Multiple choice | Sensory system   * Visual; Auditive; Tactile/haptic |
| Multiple choice | Approach   * Succes related / Reward; Error related / Punishment |
| Multiple choice | Type   * Knowledge of performance; Knowledge of result |
| Feedback Intensity | Multiple choice | Frequency   * 100 %; 50% - 99%; 20% - 49%; 1% - 19%; Faded |
| Multiple choice | Potency   * High; Low; Exaggerated |
| Feedback delivery | Multiple choice | Timing   * Concurrent; Terminal; Delayed |
| Multiple choice | Environment   * Physical; Virtual |
| Multiple choice | Control   * Self-controlled; Instructor controlled/yorked |
| Dropouts | Text field | In relation to the intervention. No. Why and when during the trial |
| Adverse events | Text field | In relation to the intervention. No. What and when during the trial |
| Results | Table | A grid of white squares  Description automatically generated |
| Control group | Sample size | Text field | Number of persons |
| % male | Text field | Percentage |
| Time since diagnosis | Text field | Mean (SD) / Median (IQR) |
| Age | Text field | Mean (SD) / Median (IQR) |
| Comorbidities | Text field |  |
| Severity of disability | Text field | Any clinical data from the characteristics table |
| Assistive devices | Text field | No. of people using x device (ex., Wheelchair, walker, cane, TAO) |
| Dropouts | Text field | In relation to intervention. No. Why and when during the trial |
| Adverse events | Text field | In relation to intervention. No. What and when during the trial |
| Results | Table | A grid of white squares  Description automatically generated |

***Appendix D,*** ***list of excluded studies after full text reviews***

|  |  |  |  |
| --- | --- | --- | --- |
| **Author Year** | **Title** | **Primary reason for exclusion** | **Note** |
| Akinci 2023 | The effects of robot-assisted gait training and virtual reality on balance and gait in stroke survivors: a randomized controlled trial | Wrong Comparator | Different motor tasks |
| Alwhaibi 2020 | Augmented Biofeedback Training with Physical Therapy Improves Visual-Motor Integration, Visual Perception, and Motor Coordination in Children with Spastic Hemiplegic Cerebral Palsy: A Randomized Control Trial | Wrong patient population | Age range 5-7 years |
| Ambrosini 2021 | A Robotic System with EMG-Triggered Functional Electrical Stimulation for Restoring Arm Functions in Stroke Survivors | Wrong comparator | Different motor tasks |
| Arnoni 2019 | Effects of virtual reality in body oscillation and motor performance of children with cerebral palsy: A preliminary randomized controlled clinical trial | Wrong comparator | Intervention group additional training |
| Baram 2012 | Gait improvement in patients with cerebral palsy by visual and auditory feedback. | Wrong study design | Single group |
| Berg 2016 | Early Supported Discharge by Caregiver-Mediated Exercises and e-Health Support After Stroke: A Proof-of-Concept Trial | Wrong comparator | Intervention group additional training |
| Booth 2019 | Immediate Effects of Immersive Biofeedback on Gait in Children With Cerebral Palsy | Wrong study design | Single group |
| Broderick 2018 | Mirror therapy and treadmill training enhance lower-limb motor function and muscle tone in patients with chronic stroke-a pilot randomized controlled trial. | Full text not found. |  |
| Cai 2020 | Online compensation detecting for real-time reduction of compensatory motions during reaching: A pilot study with stroke survivors | Wrong study design | Single group |
| Cantillo-Negrete 2021 | Brain-Computer Interface Coupled to a Robotic Hand Orthosis for Stroke Patients' Neurorehabilitation: A Crossover Feasibility Study | No motor training | No movement execution |
| Carey 2007 | Comparison of Finger Tracking Versus Simple Movement Training via Telerehabilitation to Alter Hand Function and Cortical Reorganization After Stroke | Wrong comparator | Intervention group additional training |
| Casellato 2019 | EMG-based vibrotactile biofeedback training: effective learning accelerator for children and adolescents with dystonia? A pilot crossover trial | Wrong patient population | Primary and secondary dystonia |
| Cataldo 1978 | Experimental analysis of EMG feedback in treating cerebral palsy | Wrong study design | Case report |
| Chen 2019 | Combined effect of virtual reality technology and manual work training on upper limb motor function in stroke patients | Full text not found. |  |
| Cheng 2001 | Symmetrical body-weight distribution training in stroke patients and its effect on fall prevention | Wrong comparator | Different motor tasks |
| Cho 2007 | Cortical activation changes induced by visual biofeedback tracking training in chronic stroke patients | Wrong comparator | Comparators no training |
| Choi 2019 | Mirror Therapy Using Gesture Recognition for Upper Limb Function, Neck Discomfort, and Quality of Life After Chronic Stroke: A Single-Blind Randomized Controlled Trial | Not extrinsic feedback | Visual illusion of movement |
| Chung 2014 | Core stabilization exercise with real-time feedback for chronic hemiparetic stroke: A pilot randomized controlled trials | Not extrinsic feedback | Intervention group copies virtual teacher |
| Colborne 1994 | Feedback of triceps surae EMG in gait of children with cerebral palsy: A controlled study. | Wrong comparator | Different motor tasks |
| Conrad 1980 | Augmented Auditory Feedback in the Treatment of Equinus Gait in Children | Wrong comparator | Different motor tasks |
| Coote 2008 | The effect of the GENTLE/s robot-mediated therapy system on arm function after stroke | Wrong study design | Single group |
| Cordo 2022 | Assisted Movement With Proprioceptive Stimulation Augments Recovery From Moderate-To-Severe Upper Limb Impairment During Subacute Stroke Period: A Randomized Clinical Trial | Not extrinsic feedback | Intervention group receives vibrations |
| Corr 2020 | Visualize to realize: Visual feedback supplemented power training for adolescents and adults with cerebral palsy. | Full text not found. |  |
| Correia 2017 | Motor Task Performance Under Visual and Auditory Feedback Post Stroke: a Randomized Crossover Trial | Wrong outcome | Measured performance during either visual or auditory feedback |
| Cozean 1988 | Biofeedback and functional electric stimulation in stroke rehabilitation | Wrong comparator | Different motor tasks |
| Croce 1996 | Augmented feedback for enhanced skill acquisition in individuals with traumatic brain injury | No motor training | Program targets non-disabled arm |
| Cruz 2014 | Motor task performance under vibratory feedback early poststroke: Single center, randomized cross-over, controlled clinical trial | Wrong outcome | Modulation of training, no measure of motor learning |
| Da Silva Cameiro 2011 | Virtual reality-based rehabilitation speeds up functional recovery of the upper extremities after stroke: A randomized controlled pilot study in the acute phase of stroke using the Rehabilitation Gaming System. | Wrong comparator | Different motor tasks |
| De Nunzio 2014 | Biofeedback rehabilitation of posture and weightbearing distribution in stroke: A center of foot pressure analysis | Wrong comparator | Different motor tasks |
| Dehingia 2016 | Comparison of the different frequencies of physical guidance and knowledge of results in learning weight bearing skills in post stroke patients | Full text not found. |  |
| Deo 2021 | Effects of Peripheral Haptic Feedback on Intracortical Brain-Computer Interface Control and Associated Sensory Responses in Motor Cortex | Wrong study design | Case study |
| Ding 2018 | Camera-Based Mirror Visual Feedback: Potential to Improve Motor Preparation in Stroke Patients | Not extrinsic feedback | Visual illusion of movement |
| Dorsch 2015 | SIRRACT: An international randomized clinical trial of activity feedback during inpatient stroke rehabilitation enabled by wireless sensing | No motor training | Daily physical activity |
| Duarte 2009 | Virtual reality System for upper limb rehabilitation in the acute phase of stroke | Full text not found. |  |
| Duff 2013 | Adaptive mixed reality rehabilitation improves quality of reaching movements more than traditional reaching therapy following stroke. | Wrong comparator | Different motor tasks |
| Duncan 1998 | A randomized, controlled pilot study of a home-based exercise program for individuals with mild and moderate stroke | Wrong comparator | Comparator usual care |
| Dunsky 2014 | Dual-task training using virtual reality: Influence on walking and balance in individuals post-stroke | Wrong comparator | Single vs. dual-task |
| El Kafy (2021). | Modulation of Upper Limb Spasticity Post-Stroke | Wrong comparator | Comparator usual care |
| Elshinnawy 2021 | Effect of visual biofeedback training on postural instability in chronic stroke patients: A controlled randomized trial | Wrong comparator | Comparator usual care |
| Enam 2019 | Augmented reality treadmill training as a modality to improve gait rehabilitation post-stroke | Full text not found. |  |
| Errante 2022 | Effectiveness of action observation therapy based on virtual reality technology in the motor rehabilitation of paretic stroke patients: a randomized clinical trial | Not extrinsic feedback | Action observation as a priming tool |
| FitzGerald 2019 | Rehabilitation of emergent awareness of errors post-traumatic brain injury: A pilot intervention | No motor training | Computer intervention |
| Flodmark 1986 | Augmented auditory feedback as an aid in gait training of the cerebral-palsied child | Wrong study design | Single group |
| Fong 2019 | Effects of Mirror Therapy and Bilateral Arm Training on Hemiparetic Upper Extremity in Patients With Chronic Stroke |  | Visual illusion of movement |
| Foo 2013 | Low-cost evaluation and real-time feedback of static and dynamic weight-bearing asymmetry in patients undergoing in-patient physiotherapy rehabilitation for neurological conditions | Wrong study design | Single group |
| Fueyo 1975 | Two types of feedback in teaching swimming skills to handicapped children | Wrong study design | Case study |
| Gandolfi 2019 | Robot-Assisted Stair Climbing Training on Postural Control and Sensory Integration Processes in Chronic Post-stroke Patients: A Randomized Controlled Clinical Trial | Not extrinsic feedback | Robot-assisted stair climbing training only |
| Gao 2021 | Investigation of optimal gait speed for motor learning of walking using the vibrotactile biofeedback system | Wrong study design | Single group |
| Gauggel 2000 | The impact of positive and negative feedback on reaction time in brain-damaged Patients | Not extrinsic feedback | Feedback not based on actual performance |
| Geiger 2001 | Balance and Mobility Following Stroke: Effects of Physical Therapy Interventions With and Without Biofeedback/Forceplate Training | Wrong comparator | Comparator usual care |
| Genthe 2018 | Effects of real-time gait biofeedback on paretic propulsion and gait biomechanics in individuals post-stroke | Wrong study design | Single group |
| Gilmore 2007 | Motor learning and the use of videotape feedback after stroke | No motor training | Participants had no functional use of affected upper extremity |
| Ha 2020 | Attentional concentration during physiotherapeutic intervention improves gait and trunk control in patients with stroke. | Wrong study design | EEG signals used to measure attention |
| Hamed 2022 | Effect of virtual reality games on motor performance level in children with spastic cerebral palsy | Wrong comparator | Comparator usual care |
| Han 2013 | The effect of virtual reality program on stroke patients with impaired standing balance | Full text not found. |  |
| He 2022 | Proprioceptive Training with Visual Feedback Improves Upper Limb Function in Stroke Patients: A Pilot Study | Not extrinsic feedback | Open vs. closed eyes |
| Hemmen 2007 | Effects of movement imagery and electromyography-triggered feedback on arm-hand function in stroke patients in the subacute phase | Not extrinsic feedback | EMG signal elicits electrostimulation to cause movement |
| Hill 2011 | The efficacy of using a combined regimen of portable robotics and a repetitive task specific practice to increase motor function in the upper arm | Full text not found. |  |
| Hiyamizu 2013 | Effects of video-feedback on balance learning in stroke patients | Full text not found |  |
| Hobbs 2020 | Can a novel 'serious gaming' technology improve upper limb sensation and function in children with cerebral palsy? A population-based cohort study and pilot randomized controlled trial. | Full text not found. |  |
| Hsieh 2020 | Treatment Effects of Upper Limb Action Observation Therapy and Mirror Therapy on Rehabilitation Outcomes after Subacute Stroke: A Pilot Study | Wrong comparator | Unspecified verbal instructions, cues, and feedback |
| Hsu 2022 | Effects of a Virtual Reality-Based Mirror Therapy Program on Improving Sensorimotor Function of Hands in Chronic Stroke Patients: a Randomized Controlled Trial | No motor training | Visual illusion of movement |
| Hu 2021 | Motor Imagery-Based Brain-Computer Interface Combined with Multimodal Feedback to Promote Upper Limb Motor Function after Stroke: A Preliminary Study | No motor training | No movement execution |
| Hurd 1980 | Comparison of actual and simulated EMG biofeedback in the treatment of hemiplegic patients | No motor training | Muscle contraction alone |
| Hussein 2019 | Effect of simultaneous proprioceptive-visual feedback on gait of children with spastic diplegic cerebral palsy | Wrong patient population | Age 4-6 years |
| Ikbali 2018 | Virtual Reality in Upper Extremity Rehabilitation of Stroke Patients: A Randomized Controlled Trial | Wrong comparator | Intervention group additional training |
| Inglis 1984 | Electromyographic biofeedback and physical therapy of the hemiplegic upper limb | Wrong comparator | Different motor training |
| Intiso 1994 | Rehabilitation of walking with electromyographic biofeedback in foot-drop after stroke | Wrong comparator | Different motor training |
| Jha 2021 | Randomized trial of virtual reality gaming and physiotherapy on balance, gross motor performance and daily functions among children with bilateral spastic cerebral palsy | Wrong comparator | Different motor training |
| Jones 2015 | The use of visual feedback in upper limb stroke rehabilitation: A pilot randomized controlled trial | Full text not found. |  |
| Junata 2021 | Kinect-based rapid movement training to improve balance recovery for stroke fall prevention: a randomized controlled trial | Wrong comparator | Different motor training |
| Junior 2019 | Combining Proprioceptive Neuromuscular Facilitation and Virtual Reality for Improving Sensorimotor Function in Stroke Survivors: A Randomized Clinical Trial | Wrong comparator | Intervention group additional training duration |
| Kal 2015 | Stay Focused! The Effects of Internal and External Focus of Attention on Movement Automaticity in Patients with Stroke | Wrong study design | Single group |
| Kassover 1986 | Auditory biofeedback in spastic diplegia | Wrong study design | Single group |
| KayaKaras 2014 | The effects of Kinesio Taping on activity and participation in children with unilateral spastic cerebral palsy: Two blind-randomized control trials | No motor training | Tape wearing in daily living |
| Kayabinar 2021 | The effects of virtual reality augmented robot-assisted gait training on dual-task performance and functional measures in chronic stroke: a randomized controlled single-blind trial | Not extrinsic feedback | Intervention is multitasking combined with VR |
| Khizhnikova 2018 | Efficacy of home-based training in virtual environment in patients with stroke | Full text not found. |  |
| Kim 2015 | Mirror therapy combined with biofeedback functional electrical stimulation for motor recovery of upper extremities after stroke: a pilot randomized controlled trial | Not extrinsic feedback | Unaffected arm movements control affected arm stimulation. |
| Kim 2016 | Effects of attentional focus on motor training of the upper limb using robotics in individuals after chronic stroke | Full text not found. |  |
| Kim 2019 | Repeated Use of 6-min Walk Test with Immediate Knowledge of Results for Walking Capacity in Chronic Stroke: Clinical Trial of Fast versus Slow Walkers | Not extrinsic feedback | Between-group difference is walking speed |
| Kim 2021 | The Effects of Auditory Feedback Gait Training Using Smart Insole on Stroke Patients | Wrong comparator | Different motor training |
| Kim 2022 | Effects of Vibrotactile Biofeedback Providing Real-Time Pressure Information on Static Balance Ability and Weight Distribution Symmetry Index in Patients with Chronic Stroke | Not motor training | Different feedback immediate effect on standing |
| Kiper 2014 | Reinforced feedback in virtual environment for rehabilitation of upper extremity dysfunction after stroke: preliminary data from a randomized controlled trial | Wrong comparator | Different motor training |
| Kiper 2018 | Virtual Reality for Upper Limb Rehabilitation in Subacute and Chronic Stroke: A Randomized Controlled Trial | Wrong comparator | Intervention group additional training |
| Klobucka 2013 | Influence of virtual reality environment in robotic-assisted treadmill training on motor functions in children with cerebral palsy | Full text not found. |  |
| Klobucka 2013 | The effect of virtual reality environment during robotic-assisted locomotor training on gross motor functions in patients with cerebral palsy | Wrong patient population | Young children |
| Klochkov 2017 | Using virtual reality and upper limb unloading to correct motion synergy in poststroke patients | Full text not found. |  |
| Komiya 2021 | Effect of 6-week balance exercise by real-time postural feedback system on walking ability for patients with chronic stroke: A pilot single-blind randomized controlled trial | Wrong comparator | Different motor training |
| Krekora 2005 | Biofeedback in rehabilitation of stroke patients | Wrong comparator | Different motor training |
| Kumar 2023 | Early robot-assisted proprioceptive training FOR arm reaching in acute stroke | No motor training | No movement execution |
| Kwak 2007 | Effect of Rhythmic Auditory Stimulation on Gait Performance in Children with Spastic Cerebral Palsy | Not extrinsic feedback | Stimulus driven practice |
| Kwon 2022 | Effects of Balance Training Using a Virtual Reality Program in Hemiplegic Patients | Wrong comparator | Comparator usual care |
| Kyung-Hoon 2017 | Functional Electrical Stimulation with Augmented Feedback Training Improves Gait and Functional Performance in Individuals with Chronic Stroke: A Randomized Controlled Trial | Wrong comparator | Different motor training |
| Ledebt 2005 | Balance training with visual feedback in children with hemiplegic cerebral palsy: Effect on stance and gait | Wrong comparator | Comparator no training |
| Lee 2011 | The effect of augmented reality-based core training on balance and gait function in stroke | Full text not found. |  |
| Lee 2015 | The effects of treadmill training using real-walk simulation in stroke patients | Full text not found. |  |
| Lee 2018 | Virtual Reality Rehabilitation With Functional Electrical Stimulation Improves Upper Extremity Function in Patients With Chronic Stroke: A Pilot Randomized Controlled Study | Wrong comparator | Different motor training |
| Lewek 2018 | The role of movement errors in modifying spatiotemporal gait asymmetry post stroke: a randomized controlled trial | Not extrinsic feedback | Intrinsic feedback |
| Li 2022 | Sensorimotor Rhythm-Brain Computer Interface With Audio-Cue, Motor Observation and Multisensory Feedback for Upper-Limb Stroke Rehabilitation: A Controlled Study | No motor training | No movement execution |
| Lin 2012 | Biomechanical assessments of the effect of visual feedback on cycling for patients with stroke | Wrong study design | Single group |
| Lin 2015 | Effects of Computer-Aided Interlimb Force Coupling Training on Paretic Hand and Arm Motor Control Following Chronic Stroke: A Randomized Controlled Trial | Wrong comparator | Different motor training |
| Lin 2010 | Effects of visual feedback on neuromuscular control of LEG cycling in stroke patients | Full text not found. |  |
| Lirio-Romero 2021 | Electromyographic biofeedback improves upper extremity function: a randomized, single-blinded, controlled trial. | Wrong comparator | Different motor training |
| Liu 2016 | Effects of motor imagery and electromyographic biofeedback therapy on Upper limp functions in patients with stroke | Wrong comparator | No movement execution |
| Liu 2021 | Morphological and Functional Changes of the Tibialis Anterior Muscle After Combined Mirror Visual Feedback and Electromyographic Biofeedback in Poststroke Patients: A Randomized Trial | Not extrinsic feedback | Visual illusion of movement |
| Liu 2023 | Effects of motor imagery-based brain-computer interface on upper limb function and attention in stroke patients with hemiplegia: A randomized controlled trial | No motor training | No movement execution |
| Lourenco 2010 | Effect of different training environments on upper-limb motor recovery following stroke | Full text not found. |  |
| Lourenco 2010 | Physical and virtual reality training environments for upper limb motor recovery in chronic stroke | Full text not found. |  |
| Lupo 2018 | Effects on balance skills and patient compliance of biofeedback training with inertial measurement units and exergaming in subacute stroke: a pilot randomized controlled trial | Not extrinsic feedback | VR system effects. Control group intervention description insufficient." |
| Mackey 1989 | The use of computer-assisted feedback in a motor control task for cerebral palsied children | Wrong patient population | Young children |
| Malik 2021 | Task-oriented training and exergaming for improving mobility after stroke: A randomized trial | Wrong comparator | Intervention group additional training |
| Malouin 1985 | Effects of auditory feedback on head position training in young children with cerebral palsy: A pilot study | Wrong patient population | 2.5-5 years old |
| Mandehgary Najafabadi 2019 | Improvement of Upper Limb Motor Control and Function After Competitive and Noncompetitive Volleyball Exercises in Chronic Stroke Survivors: A Randomized Clinical Trial | Not extrinsic feedback | Effects of competition |
| Mandel 1990 | Electromyographic versus rhythmic positional biofeedback in computerized gait retraining with stroke patients | Wrong comparator | Comparator is stimulus-driven |
| Marin-Pardo 2019 | Performance differences between electroencephalography and electromyography biofeedback training in stroke rehabilitation | Wrong study design | Single group |
| Mihai 2022 | Effectiveness of radial extracorporeal shock wave therapy and visual feedback balance training on lower limb post-stroke spasticity, trunk performance, and balance: a randomized controlled trial | Not extrinsic feedback | The intervention tested is shock wave therapy |
| Montoya 1994 | Step-length biofeedback device for walk rehabilitation | Wrong comparator | Different motor tasks |
| Mugler 2019 | Myoelectric Computer Interface Training for Reducing Co-Activation and Enhancing Arm Movement in Chronic Stroke Survivors: A Randomized Trial | Not extrinsic feedback | Evaluating the effect of different intervention durations |
| Mukherjee 2010 | The effect of augmented visual feedback on motor learning of reaching movements in novel dynamic environments in chronic stroke survivors | Full text not found. |  |
| Mukherjee 2011 | Augmented visual feedback affects endpoint stiffness control in chronic stroke survivors during learning of reaching movements in a dynamic environment. | Full text not found. |  |
| Mukherjee 2016 | Virtual reality effects the learning of a gait coordination task after stroke | Full text not found. |  |
| Mulder 1986 | EMG feedback and the restoration of motor control: A controlled group study of 12 hemiplegic patients | Wrong comparator | Control usual care |
| Nalabothu 2019 | The effect of myoelectric computer interface training on arm kinematics and function after stroke | No motor training | No movement execution |
| Noh 2019 | Three-Dimensional Balance Training Using Visual Feedback on Balance and Walking Ability in Subacute Stroke Patients: A Single-Blinded Randomized Controlled Pilot Trial | Wrong comparator | Different motor training |
| Özen 2022 | Towards functional robotic training: motor learning of dynamic tasks is enhanced by haptic rendering but hampered by arm weight support. | Wrong patient population | Healthy participants |
| Park 2018 | The effects of robot-assisted gait training using virtual reality and auditory stimulation on balance and gait abilities in persons with stroke | Wrong comparator | Different motor practice |
| Park 2019 | Effects of virtual reality-based planar motion exercises on upper extremity function, range of motion, and health-related quality of life: a multicenter, single-blinded, randomized, controlled pilot study | Wrong comparator | Comparator conventional occupational therapy |
| Piron 2003 | The augmented-feedback rehabilitation technique facilitates the arm motor recovery in patients after a recent stroke. | Wrong comparator | Different motor training |
| Piron 2010 | Motor learning principles for rehabilitation: a pilot randomized controlled study in poststroke patients | Wrong comparator | Different motor training |
| Ploughman 2013 | The effects of verbal or manual cues on gait parameters during the rehabilitation phase of stroke: A randomized cross-over trial | Full text not found. |  |
| Quattrocchi 2017 | Reward and punishment enhance motor adaptation in stroke | No motor training | Perturbed movements. Motor adaptation |
| Reddy 2020 | Dynamic Surface Exercise Training in Improving Trunk Control and Gross Motor Functions among Children with Quadriplegic Cerebral Palsy: A Single Center, Randomized Controlled Trial | Not extrinsic feedback |  |
| Rendos 2021 | Verbal feedback enhances motor learning during post-stroke gait retraining. | Wrong study design | Verbal feedback vs. variable practice |
| Rietschel 2013 | Facilitating Implicit learning to improve Neurorehabilitation in stroke | Full text not found |  |
| Rong 2021 | Mirror Visual Feedback Prior to Robot-Assisted Training Facilitates Rehabilitation After Stroke: A Randomized Controlled Study | Not extrinsic feedback | Visual input for priming |
| Saleh 2017 | Neural Patterns of reorganization after intensive robot-assisted Virtual reality Therapy and repetitive Task Practice in Patients with chronic stroke | Wrong comparator | Different motor training |
| Salvalaggio 2022 | Virtual Feedback for Arm Motor Function Rehabilitation after Stroke: A Randomized Controlled Trial | Not extrinsic feedback | Virtual teacher guides “before” |
| Schmidt 1997 | Continuous Concurrent Feedback Degrades Skill Learning: Implications for Training and Simulation | Wrong patient population | Healthy participants |
| Schuster-Amft 2018 | Effect of a four-week virtual reality-based training versus conventional therapy on upper limb motor function after stroke: A multicenter parallel group randomized trial | Wrong comparator | Different motor training |
| Secoli 2011 | Effect of visual distraction and auditory feedback on patient effort during robot-assisted movement training after stroke | Wrong study design | Comparator healthy participants |
| Seeger 1983 | Biofeedback therapy to achieve symmetrical gait in children with hemiplegic cerebral palsy: long-term efficacy | Wrong study design | Single group |
| Shahmoradi 2021 | Virtual reality games for rehabilitation of upper extremities in stroke patients | Wrong study design | Single group |
| Shin 2017 | Influence of visual feedback and rhythmic auditory cue on walking of chronic stroke patient induced by treadmill walking in real-time basis | Wrong study design | Single group |
| Shin 2020 | Smartphone-based visual feedback trunk control training for gait ability in stroke patients: A single-blind randomized controlled trial | Wrong comparator | Intervention group additional training |
| Shum 2020 | Error Augmentation in Immersive Virtual Reality for Bimanual Upper-Limb Rehabilitation in Individuals With and Without Hemiplegic Cerebral Palsy | Wrong study design | Single group |
| Shumway-Cook 1988 | Postural sway biofeedback: its effect on reestablishing stance stability in hemiplegic patients | Wrong comparator | Comparator usual care |
| Simonsen 2017 | Design and test of a Microsoft Kinect-based system for delivering adaptive visual feedback to stroke patients during training of upper limb movement | Wrong study design | Single group |
| Smorenburg 2011 | The positive effect of mirror visual feedback on arm control in children with spastic hemiparetic cerebral palsy is dependent on which arm is viewed. | Wrong study design | Single group |
| Tamburella 2017 | Boosting the traditional physiotherapist approach for stroke spasticity using a sensorized ankle foot orthosis: A pilot study | Wrong study design | Feedback was provided for the therapist, not a participant |
| Thielman 2010 | Rehabilitation of reaching poststroke: a randomized pilot investigation of tactile versus auditory feedback for trunk control | Wrong comparator | Extrinsic feedback vs. intrinsic tactile feedback |
| Thorpe 2002 | The effects of knowledge of performance and cognitive strategies on motor skill learning in children with cerebral palsy | Wrong study design | Single group |
| Timmermans 2021 | Walking-adaptability therapy after stroke: results of a randomized controlled trial | Wrong comparator | Different motor practice |
| Tramontano 2020 | Effectiveness of a sensor-based technology in upper limb motor recovery in post-acute stroke neurorehabilitation: a randomized controlled trial | Full text not found. |  |
| Tretriluxana 2014 | Learning of the bimanual cup-stacking task in individuals with chronic stroke improved with dyad training protocol. | Not extrinsic feedback | Watching a similarly impaired person perform the task |
| Tretriluxana 2015 | Dyad Training Protocol on Learning of Bimanual Cup Stacking in Individuals with Stroke: Effects of Observation Duration | Not extrinsic feedback | Watching a similarly impaired person perform the task |
| Tsaih 2015 | Effects of electromyographic biofeedback muscle training on motor function and cortical excitability in stroke patients | Full text not found. |  |
| Upendranatha 2015 | Effects of visual feedback and motor imagery on reducing compensatory movement strategies in hemiplegic subjects: A pilot randomized controlled trial | Full text not found. |  |
| Valdés 2018 | Biofeedback vs. game scores for reducing trunk compensation after stroke: a randomized crossover trial | Wrong study design | Only 10 min elapsed between feedback conditions. |
| Wang 2017 | Effect and mechanism of mirror therapy on rehabilitation of lower limb motor function in patients with stroke hemiplegia | Not extrinsic feedback | The visual illusion of movement |
| Widmer 2014 | Does motivation matter in upper-limb rehabilitation after a stroke? ArmeoSenso-Reward: Study protocol for a randomized controlled trial | Full text not found | The study was terminated due to futility considerations |
| Winstein 1989 | Standing balance training: Effect on balance on locomotion in hemiparetic adults | Wrong comparator | Different motor training |
| Winstein 1999 | Motor learning after unilateral brain damage | Wrong comparator | Comparator healthy participants |
| Xiong 2015 | Evaluation of clinical curative effect of myoelectricity triggering biofeedback in treatment of early hemiplegia of cerebral infarction patients | Full text not found. |  |
| Yang 2011 | Improving balance skills in patients who had stroke through virtual reality treadmill training | Wrong comparator | Different motor training |
| You 2005 | Virtual reality-induced cortical reorganization and associated locomotor recovery in chronic stroke: An experimenter-blind randomized study | Wrong comparator | Comparator, no intervention |
| Yuan 2021 | Effect of BCI-Controlled Pedaling Training System With Multiple Modalities of Feedback on Motor and Cognitive Function Rehabilitation of Early Subacute Stroke Patients | Not extrinsic feedback | Feedback on level of attention, not on motor performance |
| Zakharov 2020 | Stroke Affected Lower Limbs Rehabilitation Combining Virtual Reality With Tactile Feedback | Not extrinsic feedback | Visual and tactile simulation as a primer before motor practice |
| Zucconi 2012 | Assessment of a virtual teacher feedback for the recovery of the upper limb after stroke | Full text not found. |  |

***Appendix E, characteristics of included studies***

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| --- | --- | --- | --- | --- | --- | --- |
|  | **Methods** | **Diagnosis and participant characteristics at baseline** | **Motor training (all groups)** | **Extrinsic feedback (EF)** | **Outcome measure (all groups)**  **(Bold= included in meta-analysis)** | **Dropouts and missing data** |
| **Abdollahi 2011**  **[43]** | Randomized cross-over.  Assessor and participant blinded.  Lab setting | IG and CG: Late chronic cerebral stroke (>6 months).  N=19, age 59 (11) years. | The participants and therapist sat in front of a virtual display. The participant's hand was attached to a robot handle, and a therapist held a position tracker. A projected image of the therapist's hand and a green cursor representing the participant's hand position were displayed on a projection screen and two mirrors, creating an interactive 3D environment for various upper extremity movements.  Dose: 60 min., three times/week for two weeks.  Usual training during research intervention: not disclosed | IG: Haptic EF (via robot-rendered forces) and graphic (via a virtual environment) distortions to amplify upper-extremity (UE) tracking errors.  CG: No EF | Arm motor section of Fugl-Meyer; Wolf Motor Function Test; Assessment of Simple Functional Reach; Box and Blocks.  Measured at baseline and end of treatment | None |
| **Abdollahi 2014**  **[42]** | Randomized cross-over.  Assessor, therapist, and participant blinded.  Lab setting | IG and CG: Late chronic cerebral stroke (>6 months).  N=26, 12 male, age range 36-88 years, mean age 57.92 years | The participants and therapist sat in front of a virtual display. The participant's hand was attached to a robot handle, and a therapist held a position tracker. A projected image of the therapist's hand and a green cursor representing the participant's hand position were displayed on a projection screen and two mirrors, creating an interactive 3D environment for various upper extremity movements.  Usual training during research intervention: Yes. | IG: Haptic (via robot-rendered forces) and graphic (via a virtual environment) distortions to amplify upper-extremity (UE) tracking errors.  CG: No EF | **Arm motor section of the Fugl-Meyer**  Wolf Motor Function Test - Functional ability  Box and Blocks.  Measured at baseline and end of treatment | One dropout. The reasons did not pertain to the study.  Group unknown |
| **Abdollahi 2018**  **[72]** | Randomized cross-over.  Assessor, therapist, and participant blinded.  Lab setting | IG and CG: Late chronic cerebral stroke  N=28, age 53.27 (14.45) years, 27% male. Time since stroke: 64.57 (57.44) months | Seated in a chair with the hemiparetic arm supported by an orthosis. A screen was placed in front where a cursor displayed movement of the left hand and another movement of the right. Reaching from a location above the centers of the thighs out to one of four target sets. When more than 70% of targets were reached, participants moved 20% further away.  Dose: 45 min, three times/week for two weeks  Usual training during research intervention: not disclosed | IG: Visual and haptic error  Augmentation. Forces applied by the robot during the treatment. An error augmenting force of 100 N/m was applied to push the affected hand away from the non-affected hand.  CG: No EF | **Arm motor section of the Fugl-Meyer**  Wolf Motor Function Test  Box and Blocks  Measured at baseline, after treatment, and one week after treatment | Two dropouts, due to medical reasons not pertaining to the study. |
| **Armagan 2003**  **[44]** | RCT. Placebo-controlled.  Hospital setting | Early chronic cerebral stroke. Inpatients.  IG: N=14, age 57 (10.53) years, 64% male, time since stroke 4.43 (1) months. Barthel 69.29 (8.05)  CG: N=13, age 57.92 (11.27) years, 62% male, time since stroke 4.77 (1.30) months. Barthel 70.38 (8.38). | Wrist extension.  Dose: 20 min., five times/week over 20 days.  Usual training during research intervention: yes | IG: EMG biofeedback. Visual and auditory signals when myoelectric potentials were at a certain magnitude.  CG: Placebo: The machine was switched on but turned away from the patient. | **Scale for Judging the Performance of the Movement Complex of Drinking from a Glass**  Brunnstrom’s Stages of Hand Recovery  Wrist active range of motion  EMG surface potential  Measured at baseline and end of treatment | None |
| **Ballester 2016**  **[63]** | Quasi randomized.  Assessor and participant blinded.  Lab setting | Late chronic cerebral stroke.  IG1: N=12, age 63.40 (9.40) years, 78% male, median time since stroke 400 (269.25-1373) days. Total UE-FM 32.33 (16.09)  IG2: N=11, 73 % male, age 54.8 (12) years, 73 % male, time since stroke median 735 (IQR 493.5-1826) days, Total UE-FM 36.89 (12.29) | Seated, uni- and bimanual target reaching and -interception.  Dose: 30 min., five times/week for six weeks.  Usual training during research intervention: yes | Virtual Gaming System with visual and auditive feedback. Both groups were rewarded with a point for every success.  IG1: Goal-oriented movement amplification in VR | Total Upper extremity Fugl-Meyer Assessment (UE-FM) and subscales UE-FM-Proximal, UE-FM-Wrist, UE-FM-Hand, UE-FM-Coordination  Measured at baseline, after one week, at the end of the intervention period, and six weeks follow-up. | IG1: Two failed to complete the intervention. One was excluded because of spatial neglect or dropout after recruitment.  IG2: Two were excluded because of spatial neglect or dropout after recruitment. |
| **Bang 2016**  **[45]** | RCT. Assessor blinded.  Hospital setting | Subacute cerebral stroke. Outpatients.  IG: N=10, age 61.34 (4.84) years, 60% male, time since stroke mean 8.9 weeks (3.12), MAL- AOU: 1.88 (.34) MAL-QOM: 2.08 (.28) MMSE: 26.48 (1.23) mAS: 1.67 (.51)  CG: N= 10, age 58.22 (5.17) years, 50% male, time since stroke mean 10.30 weeks (3.71), MAL-AOU: 1.92 (.25) MAL-QOM: 2.07 (.21) MMSE: 27.56 (1.46) mAS: 1.56 (.53) | Modified constraint-induced movement therapy, performing functional tasks while sitting.  Dose: 60 min., five times/week for four weeks.  Usual training during research intervention: yes | IG: A sensor pad at the back of the chair provided auditory feedback during modified constraint-induced movement therapy, alerting if compensatory trunk movements were made. | **Action Research Arm Test (ARAT)**  Fugl-Meyer Assessment upper extremity part (FMA-UE)  Measured at baseline and end of the intervention period. | None |
| **Bradley 1998**  **[46]** | RCT. Assessor blinded.  Hospital setting | Subacute cerebral stroke. In- and outpatients. Time since stroke: 4-6 weeks.  IG1: Mild, N=5, mean age 66.6 years, all able to walk.  IG2: Severe, N=7, mean age 72.4 years. N= 4, able to walk.  CG1: Mild, N=3, age 77, all able to walk.  CG2: Severe, N=6, age 68. N=2, able to walk. | Unspecified techniques for improving alignment in the trunk and hip, regulating muscle tone, promoting active control, enhancing weight transfer, and re-educating gait during lying, sitting, and standing based on the patient's ability and needs.  Dose: 3 times/week for six weeks  Usual training during research intervention: yes | IG1 and 2: EMG biofeedback with auditory tone and light bar.  CG1 and 2: Sham, the feedback machine was switched on but turned away from the patient and the physiotherapist. | **10-meter walk test**  Other gait kinematics  Other cognitive tests  Measured at baseline, end of intervention period. | IG2: Missing baseline data from n=3 and end-of-treatment data from n=1  CG2: Missing baseline data from n=4 and end of treatment + follow-up data from n=2 |
| **Burtner 2014**  **[78]** | CCT. No blinding.  Lab setting | Spastic hemiplegic cerebral palsy. Manual Abilities Classification System levels I–III.  IG1: N=9, age ten years and seven months (1 year and seven months), Motor-Free Visual Perception Test-3: 103.2 (12.4), Box and Block test, n (min): 52 (6.0)  IG2: N=10, age 12 years and four months (2 years and seven months), Motor-Free Visual Perception Test-3: 8.8 (13.2), Box and Block test, n(min): 46 (10.0) | Assisted arm movement following a line on a screen to perform discrete and coordinated upper limb movements. The target movements consisted of elbow extension-flexion reversal at specific amplitudes in a horizontal plane.  Dose: 1 session/day for two days.  Usual training during research intervention: not disclosed | RMSE, root mean square error presented after each trial.  IG1: Feedback presented after every trial (100% feedback)  IG2: Feedback gradually fading to 62%. | **Root Mean Square Error (RMSE)**  Measured on day one and day 2 | N=1 was excluded from the analysis as performance deteriorated with practice. Unknown to which group this participant belonged. |
| **Calabrò 2017**  **[55]** | RCT. Assessor and participants blinded.  Hospital setting | Late chronic cerebral stroke  IG1: N=12, age 60 (4) years, 58% male, time since stroke eight months (2). High blood pressure; 8 Diabetes mellitus; 5 Hypercholesterolemia; 5 Smoking; 4, Alcoholism; 0  IG2: N=12, age 63 (6) years, 58% male, time since stroke eight months (2). High blood pressure; 4, Diabetes Mellitus; 6, Hypercholesterolemia; 6, smoking; 0, Alcoholism; 3 | Robotic-assisted git training. Individually adapted bodyweight support, leg guidance force, and foot-lifting straps. The gait speed was set at a maximum of 1.8 m/s. Participants were asked to walk with their maximal effort.  Dose: 40-45 min., five times/week for eight weeks.  Usual training during research intervention: not disclosed. | IG1: VR run game where the participant had to collect or avoid objects. Each avatar’s leg movement corresponded to the participant´s movements.  IG2: No avatar but a digitally displayed smile, indicating the goodness of the leg movements. | **Tinetti Performance-Oriented Mobility** **Assessment (POMA).**  Rivermead Mobility Index (RMI)  EEG- Event-related Spectral Dynamics  Measured at baseline and end of the intervention period. | None |
| **Cameirão 2012**  **[60]** | RCT. Assessor blinded.  Lab setting | Late chronic cerebral stroke  IG1: N=14, age 59.9 (13) years, 50% male, time since stroke 1334 (297) days. Barthel-100: 89.4 (6.6) Motricity Index: 56.4 (6.8) Ashworth: 1.4 (0.1) Fugl-Meyer: 35.9 (12.4) Chedoke Arm and Hand Inventory: 35.7 (18.2)  IG2: N=16, 56% male, age 68.7 (10.9) years, time since diagnosis 1649 (300) days. Barthel-100: 89.4 (11.5) Motricity Index: 55.8 (5.3) Ashworth: 1.4 (0.2) Fugl-Meyer: 34.9 (11.0) Chedoke Arm and Hand Inventory: 36.8 (20.9) | Sitting and performing a bimanual virtual task involving intercepting and grasping spheres with adjustable speed and difficulty. Before each session, patients complete a calibration task to set the difficulty level.  Dose: 35 min., five times/week for four weeks.  Usual training during research intervention: not disclosed | IG1: Haptic feedback upon successful interception and grasping.  IG2: No haptic feedback | **Fugl-Meyer Assessment test (Total)**  Fugl-Meyer Assessment test (Arm)  Fugl-Meyer Assessment test (wrist/hand)  Chedoke Arm and Hand Activity Inventory  Chedoke Arm and Hand Inventory (CAHAI)  Asworth Scale  Barthel Index  Motricity Index  Measured at baseline, end of treatment, eight weeks follow up, and 16 weeks follow up. | Three missing evaluations at the first follow-up (Week 8) and four at the second follow-up (Week 16) because the patients were not available during the evaluation period. |
| **Chaudhary, 2022**  **[75]** | RCT.  Hospital setting | Chronic hemiplegic cerebral stroke. Berg Balance score between 21-56 (low to medium risk of fall)  Outpatients.  IG1: N= 15, 48.53 (4.55) years, 73 % male.  IG2: N=15, 47.27 (3.83) years, 20% male | Standing balance training in parallel bars. Participants assumed various positions (single leg and tandem stance) on density foam and held them for 10 seconds. They also performed different activities (reaching, stepping) with various base of support, progressing to wobble board. 2 sets of 6 repetitions of each position and each activity was performed for 10 seconds.  Dose: 30 minutes, thrice a week, on alternate days for eight weeks.  Usual training during research intervention: not disclosed. | IG1: Visual Feedback provided by a mirror placed 1 meter away.  IG2: Same visual feedback combined with verbal augmented feedback provided by the therapist regarding posture correction and balance maintenance. | **Berg Balance Scale**  Measured at baseline and end of the intervention period. | None |
| **Cho 2016**  **[77]** | RCT. Assessor blinded.  Hospital setting | Spastic cerebral palsy. Outpatients.  IG: N=9, age 10.2 (3.4) years. GMFSC I (n=3), II (n=1), III (n=5) PBS 31.3 (13) 10MWT 0.4 (0.2) 2minWT 54.8 (30.1) Gross motor functional measure –Standing 63.1 (22.4) Gross motor functional measure –Walking, running, jumping 52.7 (24.9).  CG: N=9, age 9.4 (3.8) years. GMFSC I (n=3), II (n=2), III (n=4) PBS 28.1 (16) 10MWT 0.5 (0.4) 2minWT 54.8 (72.9 (45.2) Gross motor functional measure –Standing 62.0 ± 27.3 Gross motor functional measure –Walking, running, jumping 47.1 (25.8). | Treadmill Training. The participants began exercising at 60% of their target heart rate, increasing speed by 0.1 mph every 5 minutes if the heart rate stayed on target. Otherwise, they continued at the previous speed. Each session had a 5-minute warm-up, 10-minute exercise, 5-minute rest, and another 10-minute exercise.  Dose: 30 min., three times/week for eight weeks.  Usual training during research intervention: yes | IG: Jogging program of Nintendo Wii Fit Plus  CG: No VR | **Gross motor functional measure (GMFM) – standing.**  Gross motor functional measure (GMFM) - Walking, running, jumping.  Pediatric Balance Scale (PBS)  10 meter walk test (10MWT)  2-minute walk test (2MWT)  Measured at baseline and end of the intervention period. | None |
| **Cirstea 2006 and 2007**  **[32,33]** | Quasi randomized. Assessor blinded.  Lab setting | Late chronic cerebral stroke.  IG1: N=14, age 55.7 (15.4) years, 71% male, time since stroke 12.1 (4.9) months. Fugl-Meyer score 45.8 (14.1). Composite Spasticity index 6.5 (1.7). TEMPA total -32.8 (29.1).  IG2: N=14, age 59.1 (17.9) years, 50% male, time since stroke 11.4 (6.3) months. Fugl-Meyer score 40.8 (21.8). Composite Spasticity index 7.7 (2.6). TEMPA total –39.4 (24.7). | Seated performing 75 quick and precise pointing repetitions with the impaired arm without vision, relying on proprioception to hit two targets.  Dose: 60 min., ten times over two weeks.  Usual training during research intervention: not disclosed | IG1: Terminal visual feedback about movement precision every fifth trial. Subjects were asked to open their eyes after the movement and correct finger position closer to the target.  IG2: Concurrent verbal feedback about elbow and shoulder movements on a faded schedule, averaging 26.6% of trials. | Fugl-Meyer score  Upper extremity performance test for older people (TEMPA) – total  Measured at baseline and end of the intervention period. | None |
| **Cordo 2013**  **[61]** | RCT. Assessor blinded.  Lab setting. | Late chronic cerebral stroke. Severe hand impairment - most active finger extensions are less than 5 cm.  IG1: N=23, age 57 (10) years, 45% male, time since stroke 12.7 (10.8) years. MOCA 24.5±3.9  IG2: N=23, age 54 (12) years, 52% male, time since stroke 6 (7.4) years. MOCA score 23.8 (4.9) | Robotic-assisted hand movement with three vibrators over the tendons of hand muscles. Participants assisted the device as it cyclically moved the joints of the affected hand through their range of motion between hand closure and thumb and finger extension.  Dose: 30 min., 30 sessions over 11 weeks.  Usual training during research intervention: not disclosed | Participants viewed real-time visual biofeedback about volitional effort.  IG1: Torque biofeedback  IG2: EMG biofeedback | **Fugl-Meyer (UE) Assessment**  Box and Block Test  Stroke Impact Scale  EMG and Torque amplitude  Measured at baseline and end of the intervention period. | IG1: 1 dropped out amid the intervention due to travel distance.  IG2: 1 dropped out due to travel distance. 2 dropped out for a different study. |
| **Crow 1989**  **[47]** | RCT. Assessor blinded.  Hospital setting. | Subacute cerebral stroke. Inpatients. Time since stroke: 2-8 weeks.  IG: N=20, age 67.4 (10.45) years, 70% male. Stratified subgroups Group I (initial BFM 0-11) - 9 Group II (initial BFM 12-22) - 1 Group III (initial BFM 23-32) - 3 Group IV (initial BFM 33 and over) - 3.  CG: N=20, age 68.05 (9.53) years, 55% male. Stratified subgroups Group I (initial BFM 0-11) - 12 Group II (initial BFM 12-22) - 2 Group III (initial BFM 23-32) - 3 Group IV (initial BFM 33 and over) – 3. | Individual upper extremity tasks aiming towards normalizing muscle tone, work for normal active movement and aim for functional goals.  Dose: 18 sessions over six weeks.  Usual training during research intervention: yes | IG: EMG biofeedback visual and auditive (click tone) | **Action Research Arm Test (ARAT)**  Bruunstrom-Fugl Meyer test (BFM), arm section.  Measured at baseline, end of treatment, and six weeks follow-up | Two passed away during treatment. One passed away during follow-up. The latter is included in the end-of-treatment analysis.  Instances did not pertain to the intervention. |
| **Dobkin 2010**  **[48]** | RCT.  Hospital setting | Subacute cerebral stroke. Inpatients  IG: N=88, age 62.9 (12.6) years, time since stroke 27.3 (78) days. Initial walking speed: mean 0.45 (0.37) m/s. National Institutes of Health Stroke Scale: mean 6.4 (3.5), modified Rankin Scale (≥2): 99%, Functional Ambulation Classification (≥4): 4.9%.  CG: N=91, age 65.1 (11.9) years, time since stroke 30.2 (53.5) days. Initial walking speed: mean 0.46 (0.34) m/s. National Institutes of Health Stroke Scale mean 6.6 (3.1), modified Rankin Scale (≥2): 97%, Functional Ambulation Classification (≥4): 4.8%. | Performed a daily 10-m walk (or shorter distance walk until 10 m was feasible) as part of a physical therapy session.  Dose: Throughout the length of admission. 42.8 (34.7) days for the intervention group and 40.4 (28.7) days for control.  Usual training during research intervention: yes | IG: Daily feedback about walking speed. For example, “Very good! You walked that in (number of) seconds.” Then, (a) “This is better by (number of) seconds” or (b) “This shows you are holding your own” or (c) “I believe that you will soon be able to walk a bit faster.”  CG: No timing or feedback on 10-meter walk results. | **Self-selected walking speed (m/s)**  Distance walked in 3 minutes (m)  Length of stay  Measured at baseline, end of treatment, and three months follow-up. | About 10% of participants in each group dropped out before the primary outcome assessment. |
| **Drużbicki 2016**  **[64]** | RCT. Assessor blinded.  Lab setting. | Late chronic cerebral stroke. All had independent gait.  IG: N=15, age 61.9 (11.4) years, 60% male, time since stroke median 36 (range 8-120) months. SW/ST ratio: mean 1.57 (CI 1.30-1.84).  CG: N=15, age 59.8 (11.7) years, 60% male, time since stroke median 38.2 (range 8-110) months. SW/ST ratio: mean 1.57 (CI 1.15-1.99) | Gait training on the treadmill.  IG: Appropriate step length and walking speed were set. Progression: treadmill speed was increased but only in the range of task completion.  CG: Walking speed according to participants' comfort zone.  Dose: 30 min., ten sessions over two weeks.  Usual training during research intervention: yes | IG: Visual biofeedback on a screen in front of the treadmill presents the real positioning of the left and right lower extremities on the ground and the area where the feet should have been positioned. | **Stance phase on the paretic LE**  Other gait kinematics  Measured at baseline, end of treatment, and six months follow up | Five missing from follow-up. One lost contact, 3 refused to participate, and one was hospitalized. |
| **Durham 2014**  **[56]** | Randomized cross-over.  Lab setting. | Late chronic cerebral stroke  IG1: N=21, age 63 (13) years, 71% male, time since stroke 7.5 (5.6) months. Fugl-Meyer: 45.6 (13.3) eNSA (poor sensation=3): 1.1 (0.4), SSTALD-receptive speech: 7.2 (2), Praxis (BUCS): 1.4 (0.6), Long-Term Memory (BUCS): 1.5 (0.7), Attention, (BUCS): 1.5 (0.8), MMSE: 8.6 (1.2)  IG2: N=21, age 59 (14) years, 71% male, time since stroke 8.7 (5.6) months. Fugl-Meyer: 42.1 (16.4), eNSA (poor sensation=3): 1.1 (0.2), SSTALD-receptive speech: 7.9 (1.2), Praxis (BUCS): 1.2 (0.4), Long-Term Memory (BUCS): 1.5 (0.6), Attention (BUCS): 1.6 (0.9), MMSE: 8.5 (1) | Seated at a table, participants performed three types of reaching tasks: (A) reaching to grasp a jar (ability to transport the hand to an object while opening and closing the hand); (B) placing a jar forward onto a table (moving an object); and (C) placing a jar on a 28-cm wooden platform (a more challenging task for more able participants).  Dose: 48 reaches in one day.  Usual training during research intervention: not disclosed | After each trial, standardized verbal feedback statements were given according to prespecified desired extremity movements.  IG1: Internal focus, e.g., `Bring your arm straight ahead rather than across your body/out to the side.`  IG2: External focus, e.g., ` Do you see the tape I have just placed on the table? (tape placed vertically between start and endpoint) Try to follow it.` | Movement duration, peak velocity of the wrist, size of peak aperture, and peak elbow extension.  Measured at baseline and after 48 reaches. | None |
| **Engardt 1993**  **[36]** | RCT  Hospital setting | Subacute cerebral stroke. Inpatient.  IG: N=20, age 64.6 (6.7) years, 80% male, time since stroke 38 (18) days. Hemianopia 4 Sensory deficits 5 Sensory loss 5 Cognitive deficits, space 3 Cognitive deficits, body image 4 Cognitive deficits, visual perception 5 Muscular hypertonus 4.  CG: N=20, age 65.1 (9) years, 45% male, time since stroke 38 (22) days. Hemianopia 2; Sensory deficits 8; sensory loss 1; Cognitive deficits, time 1 Cognitive deficits, space 5 Cognitive deficits, body image 4 Cognitive deficits, visual perception 4 Muscular hypertonus, 6 | On a force platform. Rising from the chair, standing for a while, and then sitting down. All participants were instructed to put equal weight on both feet when rising and standing.  Dose: 15 min., three times a day, five days/week for six weeks.  Usual training during research intervention: Yes. | IG: Ground reaction force feedback through auditory output. | **Fugl-Meyer Assessment**  Sit-stand (MAS, item 4)  Barthel Index  Ratio of body weight distribution, rising  Ratio of body weight distribution, sitting down  Measured at baseline and end of treatment | None |
| **Engardt 1994**  **[37]** | RCT.  Lab setting | Late chronic cerebral stroke.  IG: N=16, age 67 (6.05) years, 75% male, time since stroke 33.2 (6.6) months.  CG: N=14, age 65 (8.46) years, 29% male, time since stroke 34.3 (5.8) months. | On a force platform. Rising from the chair, standing for 1 minute, and then sitting down. All participants were instructed to put equal weight on both feet when rising and standing.  Dose: 15 min., three times a day, five days/week for six weeks.  Usual training during research intervention: Yes. At the time of follow-up, 7 pt. In the IG group, six pt. CG had discontinued their PT. | IG: Auditory output delivered a signal when the load of the paretic leg was above a threshold ratio corresponding to 20, 30, 40, and 50% of total body weight. The level was decided based on the patient’s ability of weight distribution and was increased stepwise until the patient could load 50% | **Body Weight Distribution down (%)** (for long term)  Body Weight Distribution up (%)  Time up (s)  Time down (s)  Measured at baseline, end of treatment, and follow-up. IG 33.2 months (6.6) / CG group 34.3 (5.8)) after the training period | Ten patients, unknown which groups. 2 patients were diseased; 3 patients had had a second stroke; 1 patient had become severely ill; 2 patients had moved; 2 patients could not be found |
| **Ghomashchi 2016**  **[57]** | RCT.  Lab setting. | Early and late chronic cerebral stroke. Able to stand without assistance for at least 5 min, communicate with a therapist, and have good visual and auditory acuity.  IG1: N= 16, age 64.73 (7.4) years, time since stroke 3.91 (3.27) months.  CG: N= 15, age 55.75 (13.96) years, time since stroke 8 (3.42) months. | Balance training vi platform that is free to tilt about the anterior-posterior and mediolateral axes simultaneously. Two training routines: Postural stability training to enhance the ability to maintain the platform level and weight shift training to improve the patient’s ability to shift weight in different planes.  Dose: 15 min., three times/week for four weeks.  Usual training during research intervention: yes | IG: Visual biofeedback from monitor | **Approximate entropy (ApEn) Anterior-posterior**  Approximate entropy (ApEn) Medio-lateral  Measured at baseline and end of treatment. | None |
| **Gomes 2021**  **[58]** | Randomized cross-over.  Lab setting | Late chronic cerebral stroke.  IG1: N=6, age median 64 (52.2 – 70.2) years, 66.6% male, time since stroke >6 years. FMA-UE, Nottingham sensorial test; and MMSE scores were 54.5 (median: first quartile/third quartile: 49.5/55.7);152 (143.7/153); and 21.0 (20.5/21.0) and 28.0 (26.0/29.0) (respectively, for the three illiterate and three educated participants), respectively.  IG2: N=6, age median 66 years (52.2 – 70.2), 66.6% male, time since diagnosis >3 years. FMA-UE, Nottingham sensorial test and MMSE scores were 53(49/54.7), 143.5(137.5/148), and 21 and 24.0 (24.0/26/0) (1 illiterate and five educated participants, respectively). | Two tasks involve reaching and grasping with their affected upper limb. These tasks included reaching, pointing, reaching, holding, and fitting an object. The therapist demonstrated the movements and observed the participant's strategies before directing them to complete 16 repetitions with a verbal command.  Dose: 40-50 min. on one day  Usual training during research intervention: not disclosed | After each trial, standardized verbal feedback statements were given according to prespecified desired extremity movements.  IG1: Internal focus, e.g., ` Try to keep your elbow close to your body.`  IG2: External focus, e.g., ` See this sticker on the table? Try to follow it.` | **Movement Time (s)**  Velocity (cm/s)  Peaks velocity (n)  Measured at baseline and end of treatment | None |
| **Goodman 2014**  **[65]** | RCT.  Lab setting. | Late chronic cerebral stroke  IG1: N=13, age 62.3 (4.3) years, 38.5% male, time since stroke median 65.2 (9-152) months. Baseline Gait Velocity 78.86 (40.06) cm/s. 2 Ankle foot orthosis; 1 Quad-point cane; 2 single point cane.  IG2: N=14, age 59.2 years (5.4), 35.7% male, time since stroke 155.2 months (33-330). Baseline Gait Velocity 89.45 (45.95) cm/s. 4 Ankle foot orthosis 2; Single point cane 1; Wheelchair (excluded from gait analysis) | Seated video game where participants moved their affected ankle to control a cursor through gates on the screen. An impedance controller provided robotic assistance when needed, but not enough to passively move the ankle to the target.  Dose: 60 min., three times/week for three weeks  Usual training during research intervention: not disclosed | IG1: Monetary rewards at the end of each winning block, receiving between $0 and $25 per session.  IG2: Sparse but controlled social interaction without verbal encouragement, scoring feedback, or prizes. | **Preferred, self-selected walking velocity measured in centimeters/second.**  Cadence (steps/min).  Other gait kinematics  EEG-Frontoparietal Coherence  Measured at baseline and end of the intervention period. | Seven in all. 2 due to illness unrelated to study, 1 failed to comply with testing and training schedule, one returned to physical therapy, one was unable to because of a new job, one fell out of contact, and one relocated. |
| **Hayward 2011**  **[49]** | RCT. Assessor blinded.  Hospital setting. | Subacute cerebral stroke. Inpatient.  IG1: N=5, age 69 (10) years, 50% male, time since stroke 46 (12) days. Total FIM range: 30-35  Motor-FIM range: 13-25, Cognitive FIM range: 8-17.  IG2: N=5, age 56 (24) years, 75% male, time since stroke 26 (6) days. Total FIM range: 32–82, Motor-FIM range: 15–47, Cognitive FIM-range: 16–35 | Seated in a chair. The affected hand is stabilized in a splint attached to a track, constraining the reaching movement to a straight-line trajectory. The goal was to move the hand toward the maximum passive reach distance. The goal's distance increased to match the average reach distance of the previous practice set.  Dose: 60 min., five times/week for four weeks. Usual training during research intervention: yes | IG1 and 2: Bar displayed on a computer screen. The bar's height and color varied according to the extent of reach. When the goal was achieved, the computer screen burst into gold.  IG1: Additional electric stimulation to triceps triggered automatically when participant surpassed their personal threshold distance. | **Motor Assessment Scale Item 6, Upper Arm Function (MAS6)**  Motor Assessment Scale Item 7, Hand Movements  Motor Assessment Scale Item 8, Advanced Hand Activities  Triceps strength  Modified Ashworth Scale  Measured at baseline and end of the intervention period. | One was excluded during the trial because of multiple strokes. |
| **Hemayattalab 2010 [79]** | CCT.  Lab setting | Cerebral palsy. No visible disabilities in hand performance and no gross visual or mental deficits. They were all novices in the task.  Age range 7-15 years old  IG1: N=8  IG2: N=8  CG: N=8 | Throwing darts with the less affected dominant hand. The Dartboard was equipped with an electrical sensor that could turn off the dart screen so participants could see the result of their actions.  Dose: 30 throws (6 blocks of 5 trials) in 8 sessions on one day.  Usual training during research intervention: not disclosed. | IG1: Feedback of score after every trial (100%)  IG2: Feedback of score in 50% of trials  CG: No EF | **Dart score**  Baseline and acquisition test. The retention test was run three days later. | None |
| **Hemayattalab 2013**  **[80]** | CCT. Participant blinded.  School setting | Cerebral palsy. None of the participants had previous experience with the task.  Age 11.9 (1.6) years, GMFCS levels I-III  IG1: N=10  IG2: N=10 | Participants used their non-dominant arms to throw beanbags at a darts target. Participants wore opaque swimming goggles in the acquisition phase and could not see the target area.  Dose: 80 trials in one day.  Usual training during research intervention: not disclosed. | Verbal information of scores, the direction, and the distance of the throw.  IG1: Self-controlled: Could request feedback whenever needed.  IG2: Yoked: Replicated feedback schedules of IG2 without any choice. | Dart score.  Baseline and acquisition test. After 24 hours, participants returned to complete a 10-trial retention test and then a 10-trial transfer test. | None |
| **Hemayattalab 2014**  **[81]** | RCT.  Lab setting | Cerebral palsy. No visible disabilities in hand performance and no gross visual or mental deficits. They were all novices in the task.  Age 12.26 (3.11) years, 100% male.  IG1: N=8  IG2: N=7 | Throwing darts with the less affected dominant hand. The Dartboard was equipped with an electrical sensor that could turn off the dart screen so participants could see the result of their actions.  Dose: 30 throws (6 blocks of 5 trials) in 8 sessions on one day.  Usual training during research intervention: not disclosed. | IG1: Self-controlled. Allowed to access feedback on their throwing score after 50% of trials whenever they wanted.  IG2: Instructor -controlled and received knowledge of results after 50% of both good and bad trials. | Dart score.  Baseline and acquisition test. After 24 hours, participants returned to complete 5-trial retention and 5-trial transfer tests. | None |
| **Iguchi 2019**  **[62]** | CCT  Lab setting | Late chronic cerebral stroke  IG1: N=2, ages 61 and 76- years old, 4- and 11-years since stroke. Both males. 39- and 44-degree active ROM dorsiflex  IG2: N=2, ages 59 and 64 years old, 3- and 3.5-years since stroke. One male. 40 and 44 active ROM dorsiflex. | Seated tracking task with paretic ankle. A line was generated from an angle signal and automatically moved from left to right on a monitor at the beginning of each trial. The participant moved the line up or down by dorsi- or plantarflexing the ankle.  Dose: Repeated tracking 60s each on one day.  Usual training during research intervention: not disclosed. | Both groups received visual biofeedback from angle signals and auditory signals, alerting them to errors between the target and the joint angle. When the participant needed to plantar flex their ankle = downward intonation, and when the participants needed to dorsiflex their ankle = upward intonation.  IG1: No error=no sound.  IG2: No error = two sounds (from target and angle) with identical frequency. | Accuracy Index  Baseline and Acquisition | None |
| **Jung 2020**  **[59]** | RCT. Assessor blinded.  Lab setting. | Early and late chronic cerebral stroke.  IG: N=10, age 57.1 years (11.4), 70% male, time since stroke 6.3 (2.6) months. MMSE, 26.9 (2.0) FAC, 1-2  CG: N=10, age 56.3 years (17.1), 70% male, time since stroke 7 (2.5) months. MMSE mean 27.3 (2.4) FAC 1-2 | Overground gait training.  Dose: 30 min., five times/week for four weeks.  Usual training during research intervention: not disclosed. | IG: Trained with a cane equipped with a pressure sensor. A beeping sound was produced whenever participants pressed the cane with a higher force than the threshold. The threshold was set weekly and decreased by 10 % once participants could walk without producing a beeping sound for more than 80% of the total number of steps on the paretic side. | **Timed up and go.**  Trunk impairment scale, total  Peak vertical force on cane (% BW) Average force data from 10 gait cycles over 7m.  Measured at baseline and end of the intervention period | None |
| **Kim 2017**  **[66]** | Quasi randomized.  Lab setting | Late chronic cerebral stroke  IG1: N=15, age 57.3 (16.7) years, 47% male, time since stroke 5.4 (3.2) years. Arm impairment, moderate/severe = 7/8  IG2: N=18, age 58.9 (8.1) years, 46% male, time since stroke 4.7 (3.7) years. Arm impairment, moderate/severe 8/7 | Upper limb practice using robotics. Following an 8-point clock pattern that involved shoulder flexion, extension, adduction, and abduction to move a yellow ball.  Dose: 30-90 min., three times/week for four weeks.  Usual training during research intervention: Not disclosed. | Performance feedback scores to both groups every 80 repetitions on the amount of assistance provided, rate of initiation, and distance from the target.  IG1: External focus. Practiced with a video monitor "on" and an occluded arm to maximize attention on the video screen and the moving of the yellow ball. IG2: Internal focus. They are practiced with a video monitor "off" and a non-occluded arm to maximize attention to the movement of the arm rather than an external task goal. | **Arm motor section of Fugl-Meyer Assessment (FMA-UE)**  Wolf Motor Function Test (WMFT)  Dosage of practice.  Arm kinematics  Measured at baseline, end of intervention period, and 4-week follow-up. | Three early withdrawals from IG2. 2: Transportation difficulties; 1 withdrawn because of complaints of increased muscle stiffness and finger numbness during arm training. |
| **Maggio 2021**  **[50]** | RCT.  Hospital setting | Subacute and early chronic cerebral stroke.  IG1: N=30, age 50.4 (11.6) years, 37% male, time since stroke 3 (1) months. MOCA, median 22 (21-24)  IG2: N=15, age 48.2 years (12.2), 53% male, time since stroke 3 (1) months. MOCA, median 22 (21-24). | Robotic-assisted treadmill gait training with treadmill speed progressively increasing up to 1.8 m/s. All device parameters were individually adapted to patients’ clinical progress.  Dose: 60 min. Five times/week for eight weeks.  Usual training during research intervention: Yes | IG1: Virtual reality walking race game. The movements of the avatar corresponded to those performed by the patient.  IG2: Received a smiley face indicating the goodness of movement execution. | **Fugl-Meyer Assessment scale for lower extremities (FMA-LE)**  Body Esteem Scale (BES)  Body Uneasyness test (BUT)  Frontal Assessment Battery (FAB)  Beck Depression Inventory (BDI)  Shortform-12 Health Status (SF-12)  EEG- Spectral Analysis  Measured at baseline and end of the intervention period. | None |
| **Maulucci 2001**  **[76]** | CCT  Lab setting | Cerebral stroke. Stable eyesight with normal hearing and language function. Time since stroke unknown.  IG: N=8, ages 50-70, 63% male  CG: N= 8, ages 50-70, 63% male | Seated and harnessed at the upper torso, facing three targets. Lights from one target were turned on, and a gentle tone was emitted to begin the reach with impaired UL. A trial ended when the target was touched. If the participant failed to touch the target, the trial ended after 15 seconds.  Dose: 42 trials, three times/week for six weeks.  Usual training during research intervention: Not disclosed | IG: Auditory feedback throughout the reach.  If the hand was outside the normal path, a tone was emitted- the farther outside, the higher the tone's frequency until maximum frequency. Thus, information on the existence of error as well as magnitude. | % movement time spent outside normal path region without feedback  Baseline, end of the intervention period, and two weeks follow-up | None |
| **Mirelman 2009+2010**  **[34,35]** | RCT. Assessor blinded.  Lab setting | Late chronic cerebral Stroke  IG1: N=9, 61.8 (9.94) years, 78% male, time since stroke 37.7 (25) months. Berg 48 (7.8, 31–54) FM LE score 24±3.4 (19–28) Initial walking speed 0.65 (0.25) (0.18–1.08) m/s. Ankle foot orthosis, n= 5  IG2: N=9, age 61 (8.32) years, 89% male, time since stroke 58.2 (26.3) months. Berg 46 (7.6, 37–55), FM LE score 22 (4.5, 15–28) Initial walking speed m/s 0.67 (0.28, 0.13–1.1). Ankle foot orthosis, n=7. | Seated on a chair, participants performed dorsi- and plantarflexion, inversion, eversion, and a combination of these movements. Training intensity and protocol progression were adjusted for individual subjects relative to accuracy and reported fatigue.  Dose: 1 hour, three times/week for four weeks.  Usual training during research intervention: Not disclosed | IG1: Robotic low level force feedback and Virtual reality. Using ankle movements to navigate a plane or boat through a virtual environment that contained a series of targets. The position and timing of the targets were manipulated to ensure that training included discrete and combined ankle movements.  IG2: Robotic low level force feedback. The computer screen was occluded to block visual and auditory feedback. A therapist instructed the subjects on the direction of movement, and a metronome was used to pace for timing to ensure a comparable number of repetitions of each ankle joint movement between the groups. | **Self-selected walking speed, m/s (7-meter walkway)**  6 min. walking test  Other gait kinetics and kinematics  Patient Activity: Monitor distance km, walked in 7 Days  Measured at baseline, end of the intervention period, and three-month follow-up | None |
| **Perell 2000**  **[67]** | RCT  Hospital setting | Late chronic cerebral stroke.  IG: N=4, ages 64-77, 100% male, time since stroke 1.5-13 years. Sensation intact/decreased, 2/2 Proprioception intact/moderate loss, 1/3 Kinesthesia, intact/moderate loss, 1/3. Quad cane, two ankle foot orthosis, three wheelchairs, and one single-point cane.  CG: N=4, ages 56-76, 100% male, time since stroke 0.5 – 4 years.  Sensation intact/decreased 3/1; Proprioception intact/mild loss, 3/1; Kinesthesia, four intact.  3 quad cane; 2 ancle foot orthosis; 2 wheelchair; 1 Single point cane. | Bicycling. self-selected comfortable speed (22-59 revolutions pr. minute) at a moderate resistance of 28-70 W. Resistance was increased in one setting (mild, moderate, high) each time the subject could maintain 40 RPM throughout two consecutive sessions at the current setting.  Dose: 12 one min. Trials are conducted three times/week for four weeks.  Usual training during research intervention: Not disclosed | IG: Visual kinetic feedback: Patterns (force profile) that approximated effective force bilaterally after each trial during the rest periods. The contralateral LL was used as a template for the involved LL. In addition, verbal cues to push harder on the pedal or to push forward or pull backward during rest periods. | **Maximum Normal pedal force of involved limb**  Maximum Tangential Pedal Force – involved  Minimum Tangential Pedal Force – involved  Measured at baseline and after the intervention period. | None |
| **Phonthee 2020**  **[68]** | Quasi randomized. Assessor blinded. Community center setting | Late chronic cerebral stroke  IG: N=18, age 52.50 (8.63) years, 83% male, time since stroke 29.39 (24.8) months. 3 Single canes and 6 Tripod canes.  CG: N=18, age 54.28 (12.77) years, 72% male, time since stroke 37.78 (40.37) months. | Stepping training. Participants stand in a step-standing position. The affected limb was placed anterolateral to the non-affected limb. They were then instructed to shift their body weight onto the affected limb as much as possible before stepping forward and backward with the non-affected limb.  Dose: 30 min., five times/week for four weeks.  Usual training during research intervention: Not disclosed | IG: Participants placed their affected foot on a digital load cell and shifted their weight onto it until the green zone of a traffic light bar on a screen lit up and sounded a beep. Then, they stepped their non-affected limb forward and backward. | **Timed Up and GO**  10 Meter Walk test  6-Minute Walk Test  Lower limb support ability and other gait kinematics  Measured at baseline after a first training session, after two weeks and four week of intervention. | Three participants dropped out during training due to health problems. |
| **Pignolo 2020**  **[41]** | RCT. Assessor blinded. Hospital setting. | Acute cerebral stroke  IG: N=21, age 66.9 (12) years, 76% male; time since stroke 17.6 (15.1) days. Tinetti-Gait 1.3 (1.1), Tinetti balance 1.6 (1.3), FM-LE 42.1 (17.6)  CG: N=21, age 66.2 (14.5) years, 72% male; time since stroke 17.2 (15.2) days. Tinetti gait 1.6 (2.6), Tinetti balance 2.5 (1.6), FM-LE 40.8 (17.5) | Gait training with body weight support.  Dose: 60 minutes, five times/week for six weeks.  Usual training during research intervention: Yes | IG: A pair of sensor insoles transfers information on balance symmetry and weight distribution to a monitor. The sensor insoles measure the support times for each foot and the number of support changes. The patient continuously receives real-time information about their gait performance and can check their results during exercises with visual feedback. The system also alerts the user when the target has been achieved. | **Tinetti Gait**  Tinetti balance  FMA LE  Functional independence measure  Trunk control test  Measured at baseline, at the end of the intervention period | IG: One dropped out before intervention commencement, due to illness.  CG: One dropped out of follow up outcome measure, due to illness |
| **Platz 2001**  **[51]** | Quasi randomized.  Community center setting. | Subacute cerebral stroke or traumatic Brain Injury  IG: N=20. 14, Cerebral stroke; 6, Traumatic Brain Injury. Age 54 (18) years, 70% male, time since injury 6.2 (7.1) weeks. Motricity Index paretic arm: 83(8.2)  CG: N=20  Cerebral stroke/Traumatic Brain Injury: 16/4, 55% male, time since injury 6.1 (3.6) weeks. Motricity Index paretic arm: 87 (6.3) | Arm ability training: aiming, tapping, pen work, turning coins, maze tracking, picking up bolts, placing small and larger objects.  Within each task, a variation of task difficulty was implemented (i.e., various sizes of targets for aiming). Each patient was continuously assessed to determine the difficulty level and how many repetitions he/she could perform.  Dose: 15 min., 32 sessions over three weeks.  Usual training during research intervention: Yes | IG: Knowledge of results was shown on bar diagrams on a computer screen that indicated their progress. Because patients were not allowed to compromise the accuracy demands of training tasks, any improved efficiency of motor performance was reflected in a reduced time demand.  CG: No knowledge of results | **Test Evaluant les Membres superieurs des Personnes Agees (TEMPA)**  Measured at baseline, at the end of the intervention period, and one year follow up | IG: 5. During the intervention period, because of personal, organizational, or medical reasons. Nine came back for follow-up.  CG: 4 During the intervention period, for personal, organizational, or medical reasons, fourteen came back for a follow-up. |
| **Popović 2014**  **[69]** | RCT. Assessor blinded.  Hospital setting. | Late chronic cerebral Stroke. Outpatients.  IG: N=10, age 58 (8) years, time since stroke 17 (14) months. Fugl-Meyer, UE 35 (8).  CG: N=10, age 57 (12) years, time since stroke 20 (14) months. Fugl-Meyer, UE: 34 (5). | Seated in a chair, with their trunk secured by harness. Patients moved the manipulandum handle to perform the task.  Dose: 25 min., five times/week for three weeks.  Usual training during research intervention: Yes | IG: visual feedback via a three-stage video game. The score was displayed during the game to allow patients to follow their performance. “Cash register” sound. A high-score list was shown after each session, where patients could compare their performance to previous days and others. Three exercises. | **Modified drawing test (mDT – smoothness)**  Modified drawing test (mDT – speed)  Modified Drawing test (mDT – Precision)  Received therapy time (RTT)  Measured at baseline and after the intervention period | During the inclusion period, 1 participant was randomly excluded from the 21 eligible participants to achieve an equal sample size in the two groups. |
| **Powers 2021**  **[70]** | RCT  Lab setting | Late chronic cerebral stroke.  CG: N=4, age 63 (8.29) years, 100% male, time since stroke 3.58 (1.35) years. Walking speed 0.9 (0.10) m/s, temporal gait asymmetry ratio 1.36 (0.10).  50A: N=2, 100 % male, age 74.5 (12.02), time since stroke 4.65 (2.9) years. Walking speed 0.84 (0.3) m/s, temporal gait asymmetry ratio 1.35 (0.14).  100A: N=4, age 61 (15.21) years, 50% male, time since stroke 5.55 (2.98) years. Walking speed 0.74 (0.15) m/s, temporal gait asymmetry ratio 1.32 (0.3).  50B: N=4, age 64.75 (9.43) years, 50% male, time since stroke 2. (1.61) years. Walking speed 0.81 (0.1) m/s, temporal gait asymmetry ratio 1.36 (0.23).  100B: N=4, age 66.75 (1.89) years, 50 % male, time since stroke 12.15 (12.02) years. Walking speed 0.78 (0.13) m/s, temporal gait asymmetry ratio 1.34 (0.22). | Participants were asked to walk at their own pace over a pressure-sensitive mat placed on the ground. Prior to this, they were provided with a verbal description of the typical timing of gait events, such as the symmetrical stance time between the right and left leg and how stroke affects the timing of these events.  Dose: Up to 25 trials lasting 30 seconds in one day were used. The number of trials was adjusted according to participant tolerance.  Usual training during research intervention: Not disclosed | Terminal visual feedback on a tablet.  IG1 and 2: Display A, Temporal gait asymmetry ratio was represented by a solid vertical line, and a dashed line at 1.00 represented perfect symmetry. The position of the solid line indicated which leg had a longer stance duration. Participants were instructed to move the solid line closer to the dashed line. IG1 on alternate trials (50%), IG2 after every trial (100%).  IG3 and 4: Display B, graph depicted the mean duration of both the right and left stance phases as two bars of different colors. Participants were instructed to walk in a way that would give equal height to both left and right bars. IG3 on alternate trials (50%) IG4 after every trial (100%). | **Walking speed, m/s**  Temporal gait asymmetry ratio  Measured at baseline and retention testing 24 hours later. | Groups 50A and 100A were prematurely cancelled due to participants not understanding display A.  Missing baseline walking speed for one person in IG3. |
| **Ragab 2019**  **[74]** | CCT.  Lab setting | Cerebral stroke.  G1: Mild. N=15  G2: Mild. N=15  G3: Moderate. N=15  G4: Moderate. N=15 | Forward arm reaching 90 degrees from a sitting position.  Dose: 60 min., three times/week for six weeks.  Usual training during research intervention: Not disclosed | G1 + G3 Mirror as a visual FB. G2 + G4: Verbal instructions as an auditory FB. | Wolf Motor function test (WMFT) for functional performance  Wolf Motor function test for the time of motor performance.  Measured at baseline and the end of the intervention period | None |
| **Sackley 1997**  **[38]** | RCT. Assessor blinded.  Hospital setting. | Acute, subacute, and early chronic cerebral Stroke. In-and outpatients  IG: N=13, age 60.8 (12.3) years, 77 % male, time since stroke 20.1(18.8) weeks.  CG: N=13, age 67.9 (9.2) years, 77% male, time since stroke 18.8 (19.3) weeks. | Practicing on a balance platform with the constant supervision of at least one physiotherapist. Standing and balancing, as well as activities including targeting, reaching, stride standing, and stepping.  Dose: 60 min., three times/week for four weeks.  Usual training during research intervention: yes | IG: Two columns displaying weight distribution and weight shift activity. A red triangle appeared when columns were within 5 % of each other, confirming that stance symmetry had been achieved.  CG: The display does not move when there is a change in weight distribution. Exercises are performed using the subjective impressions of the patient and therapist. | **Rivermead motor assessment, Total**  Rivermead motor assessment, Gross function  Rivermead motor assessment, Leg, and trunk  Measured at baseline, after the intervention period, and at three months follow-up | CG: 1, fractured hip during the follow-up period. |
| **Sawa 2022**  **[54]** | Randomized cross-over.  Participant blinded. | Subacute cerebral stroke. Inpatients.  Age 69.9 (11.7) years, 80% male, all able to sit for 2 minutes. Time since stroke 96.6 (45.9) days.  IG1: N=11  IG2. N= 9 | Sitting balance training, feet off the ground. They were instructed to move their center of gravity to the paretic side as much as possible while keeping ischium on non-paretic side down. Participant´s center of pressure was displayed on a monitor.  Dose: 60 times pr. daily session for 2-3 days.  Usual training during research intervention: Not disclosed | IG1: Real-time visual feedback  IG2: 500 ms. Delayed visual feedback. | **Functional independence measure (FIM)**  Function in sitting test (FIST**)**  Center of pressure path (mm)  Measured at baseline and the end of the intervention period | None |
| **Subramanian 2013**  **[71]** | Cluster Randomized  Lab setting | Late chronic cerebral stroke.  IG1: N= 16, age 62 (9.7) years, 75% male, time since stroke 3.7 (2.2) years. FMA score: 41.1 (17.7). WMFT, Wolf Motor Function Test: 2.7 (1.3)  MAL-AS, Motor Activity Log, Amount Scale: 2.7 (1.1).  IG2: N=16, age 60 (11), 68.8% male, time since stroke 3 (1.9) years. FMA score: 42.1 (15.1)  WMFT, Wolf Motor Function Test: 2.8 (1)  MAL-AS, Motor Activity Log, Amount Scale: 2.9 (1) | Sitting and reaching for six targets beyond arm´s reach without touching the target. Targets followed a computer-guided sequence, and participants were to point quickly and accurately. Speed and accuracy criteria progressed when participants were successful 75% of the time.  Dose: 45 min., three times/week for four weeks.  Usual training during research intervention: Not disclosed | IG1: Physical environment. Square targets were mounted on a frame. Ping sound for meeting accuracy and speed criteria without trunk movement. Buzzer when criteria were not met, and Whoosh sound if trunk moved. IG2: Virtual environment. Replicating a supermarket scene with six consumer products. Feedback identical to IG1 and adding target size increase when criteria were met and game score. | **Wolf Motor Function Test—Functional Assessment Scale (WMFT-FAS)**  Other clinical and kinematic tests  Measured at baseline, after the intervention period, and at three months follow-up (retention) | None |
| **Talbot 1981**  **[82]** | RCT.  School setting | Cerebral palsy. Age 14 years, three months (7-21), 54% male.  IG: N=20, 18 spastic and two mixed.  CG: N=19, 17 spastic, 2 Mixed | Sitting and performing 40 tracing patterns composed of lines approximately 3.4mm thick on a 20cm x 27.5cm bond paper. Levels of difficulty sequenced the patterns, and all subjects completed them in the same sequence.  Dose: 10 minutes twice a day for 20 days.  Usual training during research intervention: Not disclosed | IG: Tracing with a special pen that projects a small beam of infrared light through the. If the light beam strays from the line, it triggers a buzzer that emits a tone. | Southern California Motor Accuracy Test (SCMAT)  Measured at baseline, after the intervention period, and at three months follow-up | IG: N=4, lost to follow up  CG: N=3, lost to follow up |
| **Tamburella 2019**  **[52]** | Randomized cross-over. Assessor blinded. | Subacute and early chronic cerebral stroke. Nonambulatory.  IG1: N=6, ages 54-79, 80% male, 38-149 days since stroke.  IG2: N=6, ages 54-72, 80% male, days since stroke 39-143. | Gait training on a treadmill. 50% body weight support and 100% guidance assistance. Gait speed 1.3 km/h. During each session, the same physical therapist was with the patient, providing guidance via verbal instructions on biofeedback management.  Dose: 40 min., three times/week for four weeks.  Usual training during research intervention: Yes | IG1: Electromyographic Biofeedback from plantar and dorsi flexor muscles, displayed on a screen in color-coded stripes. Red=over, blue=under. Patients adjusted muscle activation accordingly.  IG2: Joint Torque biofeedback for stance and swing phases, generating positive feedback. The display showed all values per stride in line graphs for recent strides. No ankle information was displayed. | **Berg Balance Scale (BBS)**  Trunk Control Test (TCT).  At baseline, in the middle of the intervention period, and at the end of the intervention period. | One dropout. Group and reason unknown. |
| **vanVugt 2016**  **[40]** | Quasi randomized. Participants blinded.  Hospital setting. | Acute and subacute cerebral stroke. Inpatients.  IG1: N=15, 60% male. Time since injury: 39.2 (28.7) days. Barthel 70.6 (30.8)  IG2: N=19, 47% male, Time since injury 33.5 (18.3) days. Barthel 52.9 (20.6) | Piano training.  Dose: 30 min., ten sessions over 3-4 weeks.  Usual training during research intervention: Yes | Manipulating the auditory feedback timing to disrupt error-based learning.  IG1: The keyboard emitted its sounds (piano timbre) immediately upon keystroke.  IG2: The keyboard emitted the sounds after a random delay sampled from a flat distribution between 100 ms and 600 ms. | **Nine-hole pegboard test.**  Measured at baseline and end of the intervention period. | One was removed because of an unsuccessful PRE measurement due to technical difficulties. In all nine patients (21%) were discharged from the hospital before finishing the therapy program or dropped out of therapy because they no longer felt therapy was effective. |
| **Widmer 2022**  **[39]** | RCT. Assessor blinded.  Community center setting | Acute and subacute cerebral stroke.  IG1: N=19, age 63.05 (14.82) years, 73.3% male. Time since stroke 35.32 (28.16) days. Mini-Mental State Examination. Median 28 (2.0) mRS: modified Rankin Scale. Median 3.0 (1.0) NIHSS: Median 4.0 (2.5) Barthel Index: 17.0 (2.5) FMA-UE, mean 32.05 (12.04) WMFT Score, mean 3.05 (1.03) WMFT Time, median 11.83 (36.30) Box and Block test, mean 20.05 (16.97).  IG2: N=18, age 65.94 (12.02) years, 83% male. Time since stroke 41.28 (19.96) days. Mini-Mental State Examination. Median 28.5 (6.25) mRS: modified Rankin Scale. Median 3.0 (.0) NIHSS: Median 5.0 (2.75) Barthel Index: 17.5 (3.75) FMA-UE, mean 33.61 (9.75) WMFT Score, mean 3.14 (.72) WMFT Time, median 11.50 (19.87) Box and Block test, mean 14.50 (11.60) | Seated practicing fast 3-dimensional target reaching with affected upper extremity.  Dose: 60 min. Five days/week for three weeks.  Usual training during the research period: Yes | IG1: virtual arm on a computer screen to stop meteors from destroying a planet. Includes visual effects, summary scores, and monetary rewards. The earlier the meteor was caught, the higher the score. If missed, the planet gets damaged. Money was deducted for every missed meteor.  IG2: virtual hand, a green decagon, on a computer screen to prevent pill-shaped, single-colored targets from reaching the bottom. No visual effects or monetary rewards. When touched, targets disappeared with a delay of 1 s. | **Box and Blocks Test**  Fugl-Meyer Assessment Upper Extremity  Wolf Motor Function Test  Reaching kinematic  Baseline, end of intervention period, and three months follow-up | Three were discontinued because of soreness/pain in the shoulder. 2 lost to follow-up. Group unknown. |
| **Wong 1997**  **[73]** | RCT.  Lab setting | Cerebral stroke (92%) or traumatic brain injury (8%).  IG: N=30, age 52.5 (14.8) years, 70% male, Brunstrøm stage II n=10 III n=5 IV n=8 V n=7.  CG: N=30, age 52.8 (12.4) years, 73% male, Brunstrøm stage II n=9 III n=8 IV n=8 V n=5 | Balance training with a standing training table. The weight-loaded task of pushing and pulling a box by its handhold on the table. The weight started at 2 kg and increased by 1 kg/day, according to the person's tolerance, until a maximum of 12 kg was reached. The fixation system would be removed when the subject could maintain an upright stance steadily.  Dose: 60 min., five times/week for 3-4 weeks.  Usual training during the research period: Yes | IG: A real-time visual weight-bearing biofeedback display with two numerical light-emitting diodes and a light-illuminating balance scale was mounted on the center of the postural correction mirror. Also, an auditory alarm system provided a warning signal to the subjects. | **Percentage of weight bearing on the affected side. 0 indicated equal symmetry.**  Measured at baseline, after day 1, week 1, week 2, week 3, and week 4 of the intervention period | IG: 8 at week 3, 8 at week 4. 14 completed all tests.  CG: 10 at week 3, 9 at week 4. 11 completed all tests. |
| **Yang 2015**  **[53]** | RCT. Assessor blinded. Lab setting. | Early and late chronic cerebral stroke. Pusher syndrome.  IG1: N=7, age 62.4 (12.9) years, 57% male. Time since stroke: 6 (4) months. 2 had neglect—scale for contraversive pushing: 4.8 (1.1).  IG2: N=5, age 57.6 (17.3) years, 100% male. Time since stroke 5.8 (3.3) months. 1 with neglect. Scale for contraversive pushing 4.5 (1.0). | Participants practiced maintaining vertical body posture for 10 sec. Each time, and while engaging in rhythmic body shifting as far to the limit of balance as possible (medial-lateral, anterior-posterior, and oblique directions). Training positions were either sitting or standing according to each participant's functional ability.  Dose: 20 min., three times/week for three weeks.  Usual training during the research period: Yes | G1: Interactive visual feedback training - Nintendo Wii balance board and a customized, interactive visual feedback training program (a LabVIEW-based software)  G2: Mirror visual feedback training using a whole-body mirror | **Berg Balance Scale**  Scale for contraversive pushing  Fugl-Meyer assessment scale - upper extremity  Fugl-Meyer assessment scale - lower extremity.  Measured at baseline and end of the intervention period. | None |

A chart of a number of dots with red and green circles

Description automatically generated***A chart of multiple colored dots

Description automatically generatedAppendix F, Risk of Bias Traffic Light Plot***

**Note:** ROBINS-I

**Note:** RoB 2

***Appendix G, extrinsic feedback content***

In all studies, extrinsic feedback was delivered concurrently with practice, except for four studies [48, 51, 67, 70], where it was delivered during rest breaks or after a training session.

Knowledge of performance during practice, extrinsic information on how participants move, was examined in 18 studies [36, 37, 41-43, 45-47, 57, 59, 64, 67, 70, 72, 73, 76, 77, 82]. Knowledge of result, which focuses on the outcome of the movement itself was examined in 5 studies [38, 44, 48, 51, 68]. One study provided participants with both knowledge of performance and knowledge of result [69]

Success-related extrinsic feedback were auditory signals when myoelectric potentials were a certain magnitude during wrist extension [44], encouraging verbal feedback, “very good”, “this is better by...” about walking speed [48], auditory signals when the load of the paretic leg on a force platform was above a certain threshold of total body weight [36, 37, 68], and one study rewarded points upon participants successful performance [69]. On the other hand, error-related extrinsic feedback encompassed graphic amplification of upper-extremity tracking errors within a virtual environment accompanied by force application to push the affected hand away [42, 43, 72]. Other approaches involved auditory feedback via sensor pad during modified constraint-induced movement therapy, alerting participants to compensatory trunk movements [45], pressure-sensitive canes emitting a beeping sound upon excessive force application on the non-paretic side [59], auditory feedback indicating deviations from normal hand path during reaching tasks, with tone frequency going higher to the extent of the deviation [76], and visual kinetic feedback presenting bilateral force patterns while cycling to encourage symmetrical force generation, alongside verbal cues to push harder [67]. Finally, error-related extrinsic feedback through a pen equipped with infrared light, emitting a tone when the light beam deviated from the drawing lines [82].

Eight studies provided knowledge of successful trials and errors where extrinsic feedback was provided throughout motor practice. These included EMG biofeedback with auditory tone and visual light bar [46, 47], a jogging program of Nintendo Wii Fit Plus [77], visual biofeedback projecting real-time positioning of lower extremities during treadmill walking [41, 64], and visual biofeedback projecting real-time balance and center of center of gravity information on a monitor [57]. Additionally, extrinsic feedback through bar diagrams on a computer screen displaying weight distribution and weight shift activity indicating progress, with any improvements or deterioration in performance translating into reduced or increased time demands, respectively [51], and two columns displaying weight distribution and weight shift activity. A red triangle appeared when columns were within 5 % of each other, confirming that stance symmetry had been achieved [38].

Comparisons of different extrinsic feedback content

Approach: One study compared success- and error-related extrinsic feedback with error-related feedback alone. Participants engaged in ankle tracking of a sinus wave while receiving visual feedback and auditory sound, representing target and angle signals. The success + error group received distinct continuous sounds, while the error group triggered sound only when correction was needed [62].

Attentional focus: Three studies investigated the effect of external vs. internal attentional focus. Standardized verbal feedback statements were provided according to prespecified desired extremity movements ex. “try to follow the tape on the table” vs. “extend your elbow“ [56, 58]. Another study occluded upper extremity to focus on moving a virtual ball on a video screen vs. non-occluded arm and no virtual ball, focusing on arm movement [66]. Additionally, two studies compared torque vs. EMG biofeedback where participants viewed real-time visual biofeedback of plantar and dorsi flexor movement or muscle activity displayed on a screen in color-coded stripes [52, 61].

Intensity levels: 4 studies compared different frequency schedules, e.g. extrinsic feedback presented after every trial vs. on a faded schedule [78] or vs. 50% of trials [70, 79]. One study compared concurrent verbal feedback in 20% of trials vs. a faded schedule averaging 26.6% [32, 33]. Furthermore, five studies investigated high-incentive vs. low-incentive extrinsic feedback [34, 35, 39, 50, 55, 65]. High incentive groups received extrinsic feedback through avatars in virtual reality (VR) games [34, 35, 50, 55], or video games [65]. Groups received monetary rewards or punishment dependent on success or failure [39, 65], and one study emphasized emotional involvement in the virtual story [39]. In contrast, low incentive groups were either without VR but received digitally displayed smiles, indicating successful movement [50, 55], sparse and controlled interaction during video [65] or VR games [34, 35], and ensuring neither emotional connection nor monetary reward tied to game performance [39]. Lastly, one study examined the effect of movement amplification vs. no amplification in VR [63].

Delivery: Two studies compared concurrent vs. 500 ms. Delayed visual feedback [54] or auditory random delay between 100 ms. And 600 ms. Upon piano keystroke [40] to disrupt error-based learning. Extrinsic feedback was delivered in either a physical or virtual environment in two studies, e.g., physical target reaching created distinct sounds for success or error in meeting accuracy and speed criteria vs. VR supermarket scene reaching for consumer products [71]. Another comparison involved whole-body mirror feedback training vs. interactive visual feedback via Wii balance board [53]. Finally, four studies compared differences in control over the extrinsic feedback delivery, such as a group free to receive feedback upon request vs. a group forced to receive on the same schedule [80] or schedule controlled by an instructor [81] and lastly guided by instructor´s objective assessment vs. guided by biofeedback [38, 46].

***Appendix H, the effect of extrinsic feedback (EF) vs. no EF on the improvement of functioning in children and teenagers with CP***

***A graph of a number of individuals

Description automatically generated with medium confidence***

**Note:** g, Hedge’s *g*; SE, Standard error; SMD, Standardized mean difference; CI, Confidence interval

***Appendix I, the effect of extrinsic feedback (EF) vs. no EF on the improvement of functioning in adults with Stroke***

A table of numbers and a graph

Description automatically generated with medium confidence

**Note:** g, Hedge’s *g*; SE, Standard error; SMD, Standardized mean difference; CI, Confidence interval

***Appendix J,*** ***Contour-enhanced funnel plot. The effect of extrinsic feedback (EF) vs. no EF on the improvement of functioning in adults with stroke***

***A graph of a funnel plot

Description automatically generated***

***Appendix K, the effect of extrinsic feedback (EF) vs. no EF on the improvement of functioning in adults with stroke. Influential cases removed.***

A table of statistical data

Description automatically generated with medium confidence

**Note:** g, Hedge’s *g*; SE, Standard error; SMD, Standardized mean difference; CI, Confidence interval

Influential cases: Bang et al., 2016 [45], Perell et al. 2000 [67], and Phonthee et al.2020 [68].

***Appendix L, Influential diagnostics, extrinsic feedback (EF) vs. no EF on the improvement of functioning in adults with stroke***

[insert Appendix L\_EF vs noEF\_INF DIAG].

***Appendix M, the effect of extrinsic feedback (EF) vs. no EF, adults with stroke***

[insert Appendix M\_Forest plot\_EF vs noEF\_ML\_PER]

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***Appendix N, the effect of different extrinsic feedback frequencies on motor learning in children and teenagers with CP.***

[insert Appendix N\_FREQ\_CP]

***Appendix O, the effect of high incentive extrinsic feedback vs. low incentive on functional recovery in adults with stroke***

[insert Appendix O\_HI vs LO\_Adults]

***Appendix P, the effect of extrinsic feedback with visual plus another sensory modality vs. visual only on functional recovery in adults with stroke***

[insert Appendix P\_VISplus vs VIS\_Adults]

***Appendix Q,*** ***the effect of extrinsic feedback with an internal focus of attention vs. external on the improvement of functioning in adults with stroke***

[insert Appendix Q\_INT vs EXT\_Adults]

***Appendix R , the effect of extrinsic feedback with EMG vs. joint torque focus of attention on functional recovery in adults with stroke***

[insert Appendix R\_EMG vs TOR\_Adults]

***Appendix S, the effect of concurrent vs. delayed extrinsic feedback on functional recovery in adults with stroke***

[insert Appendix S\_CON vs DEL\_Adults]

***Appendix T, the effect of extrinsic feedback provided in a virtual vs. physical environment on functional recovery in adults with stroke***

[insert Appendix T\_PE vs VE\_Adults]