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The effect of mirror therapy on upper extremity functioning for patients post-stroke: A systematic review

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INTRODUCTION

Each year approximately 795,000 strokes occur in the United States, with one stroke occurring every forty seconds on average (Benjamin et al., 2017). A stroke occurs when blood supply to the brain becomes blocked and can lead to long-term disability or death. Functional impact following a stroke largely depends on the location and extent of brain tissue damage with upper extremity (UE) paresis being the leading cause of functional limitations. Upper extremity paresis is defined as the decreased ability to voluntarily activate muscles, resulting in weakness and slow or inefficient movements of the upper extremities (Miller et al., 2010).

Upper extremity functioning is essential for the completion of activities of daily living (ADLs). ADLs can be defined as basic self-care actions that an individual completes, such as eating, toileting, dressing, and grooming (American Occupational Therapy Association [AOTA], 2008). Due to post-stroke upper extremity paresis, up to 74% of patients will require partial or full assistance from caregivers in order to complete ADLs (Dijkers, 2013). Decreased independence in ADL performance can negatively impact an individual's overall health and well-being, as well as contribute to financial and caregiver burdens (Lang, Bland, Bailey, Schaefer, & Birkenmeier, 2013; Rigby, Gubitz, & Philips, 2009).

When upper extremity paresis is present post-stroke, rehabilitation is essential to regain or increase independence in ADLs. Multiple techniques are used in rehabilitation to treat upper extremity function post-stroke. Mirror therapy (MT) is one such technique. MT is a rehabilitation therapy which consists of placing a mirror in a person's midsagittal plane to reflect the movements of one side of the body so that the reflected image of the moving extremity is interpreted by the brain as normal movement of the opposing limb (Thieme, 2018). In the case of post-stroke treatment, the non-paretic limb is often reflected and therefore interpreted by the brain as the paretic limb. While different variations in MT setup and protocol are common, all forms work by stimulating the regions of the brain associated with movement, sensation, and pain, to help in the rehabilitation of the affected limb (Thieme, 2018). It is known that observation of movement and the performance of movement share similar cortical motor areas in the brain and that MT likely contributes to increased cortico-muscular excitability (Thieme, 2018). While this provides a basic understanding as to how MT works, precise mechanisms remain unclear (Thieme, 2018).

Due to the high incidence of stroke and the detrimental impact it can have on a patient's independence, several systematic reviews examining the effect of MT on post-stroke rehabilitation for upper extremity functioning have been conducted. However, it is necessary to provide an update to existing systematic reviews to include new clinical studies that have recently been published. Since stroke is a leading cause of disability, this study aims to determine the effectiveness of MT in post-stroke rehabilitation for upper extremity function as compared to conventional therapy.

METHODS

Development of the protocol

The methods of a systematic review were followed closely beginning with the development of an *a priori* protocol.

Identification of relevant studies:
As indicated by the protocol, the following electronic databases were searched in February of 2019: CINAHL, PubMed, TRIP, PsycINFO, OTSeeker, and OT Search. A predetermined list of subject headings and keywords (Table 1) were combined for each database to generate boolean search sentences (Table 2). Three systematic reviews were identified, and the reference lists were manually searched. Any articles that met the inclusion criteria were included in the current review but were not appraised. Search restrictions included quantitative, controlled studies published in English in peer-reviewed journals. The full inclusion and exclusion criteria can be found in Table 3.

Articles were included in the current systematic review if they met the following criteria: (1) At least half of the subjects were aged 18 or older; (2) intervention consisted of mirror therapy; (3) outcomes considered the upper extremities; (4) study design was quantitative and controlled; (5) peer-reviewed, scholarly articles.

The exclusion criteria consisted of: (1) interventions that combined mirror therapy with another intervention (i.e. CIMT), unless the mirror therapy results could be extracted.

Two independent reviewers were responsible for searching each database. Each study retrieved during the search had the inclusion and exclusion criteria applied to the titles and abstracts. After article titles and abstracts were screened to be included, reviewers discussed disagreements and resolved differences by analyzing full text articles. Documentation of disagreements and resolutions was kept throughout the entirety of the process. A third reviewer was consulted to resolve disagreements when necessary. A final list of included articles across all searched databases was made when authors reached consensus. The flowchart outlining this process can be found in Figure 1.

Appraisal of the included articles:
To increase the internal validity of the current review, two reviewers independently assessed each study. This was accomplished by systematically determining the level and quality of the evidence for each study, based on predetermined criteria (Table 4). The two reviewers were then responsible for collaboratively comparing their two independent appraisals of each study and discussing and resolving any discrepancies. A third reviewer assisted in resolving discrepancies when necessary.

Summarizing the content of each included study followed the same process: Two independent reviewers completed a previously established study description table (Table 5) and then compared their work to reach a consensus. A third reviewer assisted in resolving discrepancies when necessary. The study description table included information regarding clinical significance in each study that it was provided or could be calculated. When no measure of clinical significance was provided, the minimally detectable difference (MDD) or minimally clinically important difference (MCID) were calculated. Practice recommendations were created by using a modified version of the GRADES system (Dijkers, 2013).

Terminology

Statistical Significance: if results are statistically significant, they are unlike to be due to chance.

Quality of Evidence: the degree of rigor in a study's methodology. The quality of evidence was determined using the AOTA Level of Evidence pyramid.

Clinical Significance: results are clinically significant if the change due to the intervention is enough to make a difference in the participants' life.

Minimally Detectable Difference (MDD): The smallest amount of change on a measurement tool that is reflective of a true difference in ability.

Minimal Clinically Important Difference (MCID): The smallest difference in a variable that shows a change that is important and meaningful to the patient. This is the smallest change that a patient would consider to make a difference in their life.

Effect size: The difference between two different treatments or groups. This shows us how well an intervention worked.

RESULTS

A total of 330 articles were retrieved through database searches, forty-seven of which met the predetermined inclusion criteria. Of the forty-seven articles, twelve were appraised and three were systematic reviews that had previously appraised the remaining thirty-five articles.

As evidenced in the study description table (Table 5), the included studies used a mix of designs with an evidence level ranging from I to III. Six of the included studies were randomized controlled trials (RCTs), the highest level of evidence (i.e. Amasalyi & Yaliman, 2016). These studies used two or three groups, depending on their study purpose, collected data pre and post intervention, and randomized the allotment of their study participants. Three of the included studies used a quasi-experimental study design. Two of these studies used intervention and control groups, while one study followed a single group design.

The level of evidence in this systematic review ranged from moderate to high. Newly appraised studies ranged from low to high quality of evidence. Three studies qualified as high-quality evidence (70%+) and four studies qualified as moderate quality evidence (40%-69%). The quality of evidence table provides further details about each study (Table 4).

The included studies in this systematic review measured change in three outcomes: upper extremity function, upper extremity motor recovery, and independence in activities of daily living (ADLs).

Upper Extremity Function:

Nine of the appraised studies addressed upper extremity function and improvement in function after implementation of mirror therapy. Seven of the nine studies demonstrated a moderate to high level and quality of evidence. Outcomes included within upper extremity function are manual function, finger flexion, and upper extremity mobility. Assessments used to measure upper extremity function included: the *Fugl Meyer Assessment (FMA)*, *Brunnstrom Stages of Recovery*, *Manual Function Test (MFT)*, *Action Research Arm Test (ARAT)*, the *Wolf Motor Function Test (WMFT)*, and the *Jebsen Taylor Test*. These assessments have both high reliability and validity. Seven of the nine studies reported statistical significance (p-values ≤ 0.05). One study produced results that were not statistically significant and for one study statistical significance was not reported. Four of the nine studies produced clinically significant results regarding functional improvement of the upper extremity post MT, while two of the studies could not be interpreted for clinical significance as there was insufficient data to calculate effect size.

Twenty-four of the articles appraised in the previously existing systematic reviews addressed upper extremity function through the use of the aforementioned assessments. Twenty-three of the twenty-four are classified as level I evidence. These study results indicate that MT can produce a positive effect on improvement in upper extremity function in patients post-stroke (Ezendam, Bongers & Jannink, 2009; Perez-Cruzado, Merchán-Baeza, González-Sánchez & Cuesta-Vargas, 2017; Thieme et al., 2018). It was recommended that MT be used in conjunction with conventional therapy to produce the largest effect (Thieme et al., 2018).

Motor Recovery

Two of the appraised studies addressed upper extremity motor recovery. These studies demonstrated high levels of evidence and moderate-high quality of evidence. Assessments used included the *Brunnstrom Stages of Recovery* and the *Fugl Meyer Assessment (FMA)*. Both studies produced statistically significant results, however only one study showed clinical significance (Cristina, Matei, Ignat, & Popescu, 2015; Lee et al., 2015).

Eight of the studies previously appraised in the existing systematic reviews addressed motor recovery; all were level I RCTs. Collectively, these studies found that MT used with conventional therapy is more effective than conventional therapy alone, some found higher efficacy in MT alone, as demonstrated by both statistically and clinically significant results (Perez-Cruzado et al., 2017).

Independence in ADLs:

One of the appraised studies addressed ADL functioning (Ju & Yoon, 2018). This study demonstrated a high level of evidence and moderate quality of evidence. Fourteen studies previously appraised in the existing systematic reviews also addressed ADL functioning. The assessments used to measure ADL functioning included the *Functional Independence Measure (FIM) self-care*, *Modified Barthel Index (MBI)*, *Barthel Index (BI)*, and the *Motor Activity Log*. These assessments have both high reliability and validity. Ju & Yoon (2018) examined correlations and reported results in the correlation coefficient (r). Results of this study showed a fair positive correlation ($r = 0.31, 0.33$) between MT and improvements in toileting and dressing specifically (Ju & Yoon, 2018). Clinical significance from this study could not be calculated.

Fourteen studies previously appraised in the existing systematic reviews addressed ADL functioning; all were level I RCTs. In general, there was moderate quality evidence present that MT had a statistically significant effect on ADLs when compared to other interventions (Thieme et al., 2018).

PRACTICE RECOMMENDATIONS

Upper Extremity Function:

Using a modified GRADES classification system, the outcome of UE function received a Grade A score (Dijkers, 2013). There was moderate quality evidence and a high degree of clinical significance to support this outcome. Additionally, MT was determined to have a high benefit versus burden/cost; Associated burdens may include traveling to and from therapy, time spent in therapy, and rehabilitation costs. Further research is likely to have an impact on the efficacy of existing research. Therefore, it is conditionally recommended that clinicians use MT to address upper extremity motor function post-stroke.

Motor Recovery

The motor recovery outcome received a high-quality score (Grade A) based on the same GRADES criteria (Dijkers, 2013). There was a high quality of evidence and high amount of clinical significance. MT was also determined to have a high benefit versus burden, as described above.

Therefore, further research is unlikely to have an impact on the estimate of effect and validity of results. With regard to motor recovery, the results should be applied to patients in most circumstances.

Independence in ADLs:
The independence in ADLs outcome received a Grade B, with high quality evidence, low clinical significance, and high benefit versus burden/cost, to support use. Further research may have an impact on the estimate of effect and validity of results. The results should be applied to patients with caution.

CLINICAL IMPLICATIONS

The twelve included studies in this systematic review evaluated the efficacy of mirror therapy for improving upper extremity function in patients post-stroke. Outcomes evaluated include upper extremity function, motor recovery of the upper extremity, and independence in ADLs. In the current systematic review, quality was rated using the modified GRADES system (Dijkers, 2013). Previous systematic reviews also reported quality levels for each outcome.

Upper extremity function was classified as moderate quality using the modified GRADES system. This varied from the quality of evidence for this outcome found by Thieme (2018), which was classified as low quality. In a recently published systematic review, medium to large effect sizes were found for this outcome (Perez-Cruzado et al., 2016).

Motor recovery was classified as high quality using the modified GRADES system. Thieme et al. (2018) reported moderate quality evidence for this outcome. Perez-Cruzando (2016) reported that the preponderance of studies demonstrated improvement in motor recovery. Based on the GRADES classification for quality of evidence and the findings of the other systematic reviews, mirror therapy can be used with patients post-stroke to improve motor recovery in most circumstances. Independence in ADLs received a moderate quality score using the modified GRADES system, and a moderate quality score was also reported by Thieme et al. (2018). However, Perez-Cruzando (2016) found no improvement in ADLs with mirror therapy.

Further research is warranted, as there were apparent inconsistencies throughout appraised articles and the previously completed systematic reviews. Despite the limited equipment and limited risk involved in implementing mirror therapy, there are potential burdens for patients and their families. These burdens include the commitment to therapy sessions, as the intervention must be completed approximately 5 times each week for 30 minutes each session. Additionally, clients must be in an inpatient hospital to receive treatment. Given that the preponderance of appraised articles demonstrated improvements in upper extremity function in post-stroke patients with the use of mirror therapy, mirror therapy is a potential treatment option during the rehabilitation process, especially for upper extremity motor recovery.

Overall, positive outcomes were found for the use of mirror therapy in patients post-stroke for the following outcomes: Upper extremity function (Grade A, moderate quality), Motor recovery (Grade A, high quality), and Independence in ADLs (Grade B, moderate quality). Given the positive outcomes, low cost, and low risk associated with mirror therapy, it should be considered as a legitimate therapy option when working with patients 18+ post stroke for upper extremity function, motor recovery of the upper extremity and independence in ADLs.

REFERENCES

Acerra, N. E. (2007). Is early post-stroke upper limb mirror therapy associated with improved sensation and motor recovery? A randomised-controlled trial. *Sensorimotor Dysfunction in CRPS1 and Stroke: Characteristics, Prediction and Intervention.* Brisbane, Australia: University of Queensland.

Alibakhshi, H., Samaei, A., Khalili M. A., & Siminghalam, M. (2016). A comparative study on the effects of mirror therapy and bilateral arm training on hand function of chronic hemiparetic patients. *Koomesh Journal of Semnan University of Medical Sciences*, *17*(3), 589–595.Retrieved from: http://koomeshjournal.semums.ac.ir/files/site1/user_files_e4351e/monasimin-A-10-2153-2-57b0bec.pdf

Amasyali, S. Y., & Yaliman, A. (2016). Comparison of the effects of mirror therapy and electromyography-triggered neuromuscular stimulation on hand functions in stroke patients: a pilot study. *International Journal of Rehabilitation Research*, *39*(4), 302–307. doi: 10.1097/MRR.0000000000000186

American Occupational Therapy Association [AOTA]. (2008). Occupational therapy practice framework: domain & process 2nd edition. *American Journal of Occupational Therapy, 62*(6), 625-683. doi: 10.5014/ajot.62.6.625

Antoniotti, P., Veronelli, L., Caronni, A., Monti, A., Aristidou, E., Montesano, M., & Corbo, M. (2019). No evidence of effectiveness of mirror therapy early after stroke: An assessor-blinded randomized controlled trial. *Clinical Rehabilitation, 33*(5), 885-893. doi:10.1177/0269215518824737

Arya, K. N., Pandian, S., Kumar, D. & Puri, V. (2015). Task-based mirror therapy augmenting motor recovery in post stroke hemi-paresis: A randomized controlled trial. *Journal of Stroke and Cerebrovascular Diseases, 24*(8), 1738-1748. doi: 10.1016/j.jstrokecerebrovasdis.2015.03.026

Bae, S. H., Jeong, W. S., & Kim, K. Y. (2012). Effects of mirror therapy on subacute stroke patients' brain waves and upper extremity functions. *Journal of Physical Therapy Science, 24*(11):1119–22. doi: 10.1589/jpts.24.1119

Benjamin, E. J., Blaha, M. J., Chiuve, S. E., Cushman, M., Das, S. R., Deo, R., . . . Muntner, P. (2017). Heart disease and stroke statistics - 2017 update: A report from the American Heart Association. *Circulation, 135*(10), e146-e603. doi: 10.1161/CIR.0000000000000485

Benjamin, E. J., Virani, S. S., Callaway, C. W., Chamberlain, A. M., Chang, A. R., Cheng, S., . . . Muntner, P. (2018). Heart disease and stroke statistics – 2018 update: A report from the American Heart Association. *Circulation, 137*(12), e67-e492. doi: 10.1161/CIR.0000000000000558

Bussmann, J. B. (2011). Motor recovery and cortical reorganization after mirror therapy in chronic stroke patients: a phase II randomized controlled trial. *Neurorehabilitation and Neural Repair, 25*(3), 223-233. doi: 10.1177/1545968310385127

Cho, H. S., & Cha, H. G. (2015). Effect of mirror therapy with tDCS on functional recovery of the upper extremity of stroke patients. *Journal of Physical Therapy Science*, *27*(4), 1045-1047. doi: 10.1589/jpts.27.1045

Colomer, C., Noe, E., & Llorens Rodríguez, R. (2016). Mirror therapy in chronic stroke survivors with severely impaired upper limb function: a randomized controlled trial. *European journal of physical and rehabilitation medicine*, *52*(3), 271-278. Retrieved from: https://www.minervamedica.it/en/getfreepdf/Goz%252F9SFdikUf6B5sF5FlXuZ5W%252FarMBHpnyifqUvOnocx7Tl0y9zG5K0PfcHuTWF1VpJkFMyQ2IuKyS1TBjpW4g%253D%253D/R33Y2016N03A0271.pdf

Cristina, L. M., Matei, D., Ignat, B., & Popescu, C. D. (2015). Mirror therapy enhances upper extremity motor recovery in stroke patients. *Acta neurologica* *belgica*, *115*(4), 597-603. doi: 10.1007/s13760-015-0465-5

Dijkers, M. (2013). Introducing GRADE: a systematic approach to rating evidence in systematic reviews and to guideline development. *KT Update*, *1*(5), 1-9. Retrieved from: http://www.mitaeroa.com/pdf/c101.pdf

Dohle, C., Püllen, J., Nakaten, A., Küst, J., Rietz, C., & Karbe, H. (2009). Mirror therapy promotes recovery from severe hemiparesis: a randomized controlled trial. *Neurorehabilitation and neural repair*, *23*(3), 209-217. https://doi.org/10.1177/1545968308308324786

Ezendam, D., Bongers, R. M., & Jannink, M. J. (2009). Systematic review of the effectiveness of mirror therapy in upper extremity function. *Disability and rehabilitation*, *31*(26), 2135-2149. https://doi.org/10.3109/09638280902887768

Guo, J., Qian, S., Wang, Y., & Xu, A. (2019). Clinical study of combined mirror and extracorporeal shock wave therapy on upper limb spasticity in poststroke patients. *International Journal of Rehabilitation Research, 42*(1), 31-35. doi: 10.1097/MRR.0000000000000316

Gurbuz, N., Afsar, S. I., Ayaş, S., & Cosar, S. N. S. (2016). Effect of mirror therapy on upper extremity motor function in stroke patients: a randomized controlled trial. *Journal of Physical Therapy Science*, *28*(9), 2501-2506. https://doi.org/10.1589/jpts.28.2501

Hiragami, S. Y., Sato, Y., Harada, K., & Kagawa, K. (2012). The effect of mirror therapy on finger motor dysfunction after stroke. *Journal of Japanese Society of Physical Therapy*, *39*(5), 330–337. doi: 10.1298/jjpta.Vol16_025

In, T. S., Jung, K. S., Lee, W. L., & Song, C. H. (2010). Virtual reality reflection therapy improves motor recovery and motor function in the upper extremities of people with chronic stroke. *Journal of Physical Therapy Science, 24*(4), 339–343. doi: 10.1589/jpts.24.339

Invernizzi, M., Negrini, S., Carda, S., Lanzotti, L., Cisari, C., & Baricich, A. (2013). The value of adding mirror therapy for upper limb motor recovery of subacute stroke patients: A randomized controlled trial. *European Journal of Physical & Rehabilitation Medicine, 49*(3), 311-317. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/23480975

Ji, S. G., Cha, H. G., & Kim, M. K. (2014). Stroke recovery can be enhanced by using repetitive transcranial magnetic stimulation combined with mirror therapy. *Journal of Magnetics, 19*(1), 28–31.doi: 10.4283/JMAG.2014.19.1.028

Ju, Y., & Yoon, I. J. (2018). The effects of modified constraint-induced movement therapy and mirror therapy on upper extremity function and its influence on activities of daily living. *Journal of Physical Therapy Science*, *30*(1), 77-81. doi: 10.1589/jpts.30.77

Kim, K., Lee, S., Kim, D., Lee, K., & Kim, Y. (2016). Effects of mirror therapy combined with motor tasks on upper extremity function and activities daily living of stroke patients. *Journal of Physical Therapy Science*, *28*(2), 483–487. doi:10.1589/jpts.28.483.

Kojima, K., Ikuno, K., Morii, Y., Tokuhisa, K., Morimoto, S. & Shomoto, K. (2014). Feasibility study of a combined treatment of electromyography-triggered neuromuscular stimulation and mirror therapy in stroke patients: A randomized crossover trial. *NeuroRehabilitation, 34*, 235–244, doi:10.3233/NRE-131038

Lang, C. E., Bland, M. D., Bailey, R. R., Schaefer, S. Y., & Birkenmeier, R. L. (2013). Assessment of upper extremity impairment, function, and activity following stroke: foundations for clinical decision making. *Journal of Hand Therapy, 26*(2), 104-115. doi: 10.1016/j.jht.2012.06.005

Lee, M. M., Cho, H. Y., & Song, C. H. (2012). The mirror therapy program enhances upper-limb motor recovery and motor function in acute stroke patients. *American Journal of Physical Medicine and Rehabilitation, 91*(8), 689-696. doi: 10.1097/PHM.0b013e31824fa86d

Lee, Y. Y., Hsieh, Y. W., Wu, C. Y., Lin, K. C., & Chen, C. K. (2015). Proximal fugl-meyer assessment scores predict clinically important upper limb improvement after 3 stroke rehabilitative interventions. *Archives of Physical Medicine and Rehabilitation, 96*(12), 2137-2144. doi: 10.1016/j.apmr.2015.07.019

Lee, D., Lee, M., Lee, K. & Song, C. (2014). Asymmetric training using virtual reality reflection equipment and the enhancement of upper limb function in stroke patients: A randomized controlled trial. *Journal of Stroke and Cerebrovascular Diseases: The Official Journal of National Stroke Association, 23*, 1319–1326. doi:10.1016/j.strokecerebrovasdis.2013.11.006.

Lim K. B., Lee H. J., Yoo J, Yun H. J., Hwang H. J. (2016). Efficacy of mirror therapy containing functional tasks in poststroke patients. *Annals of Rehabilitation Medicine, 40*(4), 629–636. doi:10.5535/arm.2016.40.4.629

Lin, K. C., Chen, Y. T., Huang, P. C., Wu, C. Y., Huang, W. L., Yang, H. W., ... & Lu, H. J. (2014). Effect of mirror therapy combined with somatosensory stimulation on motor recovery and daily function in stroke patients: A pilot study. *Journal of the Formosan Medical Association, 113*(7), 422-428. https://doi.org/10.1016/j.jfma.2012.08.008

Lin, K., Huang, P., Chen, Y., Wu, C., & Huang, W. (2014). Combining afferent stimulation and mirror therapy for rehabilitating motor function, motor control, ambulation, and daily functions after stroke. *Neurorehabilitation and Neural Repair, 28*(2), 153-162. doi:10.1177/1545968313508468

Michielsen, M. E., Selles, R. W., van der Geest, J. N., Eckhardt, M., Yavuzer, G., Stam, H. J., … &
Miller, E. L., Murray, L., Richards, L., Zorowitz, R. D., Bakas, T., Clark, P., & Billinger, S. A. (2010). Comprehensive overview of nursing and interdisciplinary rehabilitation care of the stroke patient: A scientific statement from the American Heart Association. *Stroke, 41*(10), 2402-2448. doi: 10.1161/STR.0b013e3181e7512b

Mirela, C. L., Matei, D., Ignat, B., & Popescu, C. D. (2015). Mirror therapy enhances upper extremity motor recovery in stroke patients. *Acta Neurologica Belgica, 115*(4), 597-603. doi:10.1007/s13760-015-0465-5

Nagapattinam, S., Babu, K. V., Kumar, N. S., & Ayyappan, V. R. (2015). Effect of task specific mirror therapy with functional electrical stimulation on upper limb function for subacute hemiplegia. *International Journal of Physiotherapy*, *2*(5), 840–9. doi: 10.15621/ijphy/2015/v2i5/78243

Oliveira, M. da C. B., Silva, D. R. C., Cortez, B. V., Coêlho, C. K. da S., Silva, F. M. de S. e, Oliveira, G. B. V. P. de, … Moraes Silva, J. D. (2018). Mirror and Vibration Therapies Effects on the Upper Limbs of Hemiparetic Patients after Stroke: A Pilot Study. *Rehabilitation Research & Practice*, 1–6. https://doi.org/10.1155/2018/6183654

Pandian, J. D., Arora, R., Kaur, P., Sharma, D., Vishwambaran, D. K., Arima, H. (2014). Mirror therapy in unilateral neglect afterstroke (MUST trial): A randomized controlled trial. *Neurology, 83*(11), 1012–7. doi: 10.1212/WNL.0000000000000773.

Park, J. Y., Chang, M., Kim, K. M., & Kim, H. J. (2015). The effect of mirror therapy on upper-extremity function and activities of daily living in stroke patients. *Journal of Physical Therapy Science*, *27*(6), 1681-3. doi: 10.1589/jpts.27.1681

Park, Y., Chang, M., Kim, K. M., An, D. H. (2015). The effects of mirror therapy with tasks on upper extremity function and self-care
in stroke patients. *Journal of Physical Therapy Science,27(5)*, 1499–1. doi: 10.1589/jpts.27.1499.

Pérez-Cruzado, D., Merchán-Baeza, J. A., González-Sánchez, M., & Cuesta-Vargas, A. I. (2017). Systematic review of mirror therapy compared with conventional rehabilitation in upper extremity function in stroke survivors. *Australian Occupational Therapy Journal, 64*(2), 91-112. doi:10.1111/1440-1630.12342

Piravej, K., Champaiboon, J., Sontim, W., Ruengyoo, R. (2012). Effect of mirror therapy in recovering upper limb strength and function in chronic stroke patients. *Neurorehabilitation andNeural Repair, 26(6).*

Rigby, H., Gubitz, G., & Philips, S. (2009). A systematic review of caregiver burden following stroke. *International Journal of Stroke, 4*(4), 285-292. doi: 10.1111/j.1747-4949.2009.00289.x

Rodrigues, L. C., Farias, N. C., Gomes, R. P., Michaelsen, S. M. (2016). Feasibility and effectiveness of adding object-related bilateral symmetrical training to mirror therapy in chronic stroke: A randomized controlled pilot study. *Physiotherapy Theory and Practice, 32*(2), 83–91

Rothgangel, A. S., Morton, A. R., van den Hout, J. W. E., Beurkens, A. J. H. M. (2004). Phantoms in the brain: Spiegeltherapie bij chronische CVA-patiënten; een pilot-study. *Ned Tijdschr Fysiother, 114*, 36–40.

Samuelkamaleshkumar, S., Reethajanetsureka, S., Pauljebaraj, P., Benshamir, B., Padankatti, S. M., & David, J. A. (2014). Mirror therapy enhances motor performance in the paretic upper limb after stroke: a pilot randomized controlled trial. *Archives of Physical Medicine and Rehabilitation, 95*(11), 2000-2005. doi: 10.1016/j.apmr.2014.06.020

Schick, T., Schlake, H. P., Kallusky, J., Hohlfeld, G., Steinmetz, M., Tripp, F., et al. (2017). Synergy effects of combined multichannel EMG-triggered electrical stimulation and mirror therapy in subacute stroke patients with severe or very severe arm/hand paresis. *Restorative Neurology and Neuroscience*, *35*(3), 319–32. doi: 10.3233/RNN-160710

Seok, H., Kim, S. H., Jang, Y. W., Lee, J. B., & Kim, S. W. (2010). Effect of mirror therapy on recovery of upper limb function and strength in subacute hemiplegia after stroke [Abstract]. *Journal of Korean Academy of Rehabilitation Medicine*, *34*, 508–12. Retrieved from: https://www.e-arm.org/journal/view.php?number=1063

Skolarus, L. E., Freedman, V. A., Feng, C., Wing, J. J., & Burke, J. F. (2016). Care received by elderly US stroke survivors may be underestimated. *Stroke, 7*(8), 2090-2095. doi: 10.1161/STROKEAHA

Stevens, J. A., & Stoykov, M. E. (2003). Using motor imagery in the rehabilitation of hemiparesis. Arch *Phys Med Rehabil*, *84*, 1090–1092. https://doi.org/10.1016/S0003-9993(03)00042-X

Sütbeyaz, S., Yavuzer, G., Sezer, N., & Koseoglu, B. F. (2007). Mirror therapy enhances lower-extremity motor recovery and motor functioning after stroke: a randomized controlled trial. *Archives of Physical Medicine and Rehabilitation*, *88*(5), 555–9. doi: 10.1016/j.apmr.2007.02.034

Thieme, H., Bayn, M., Wurg, M., Zange, C., Pohl, M., & Behrens, J. (2013). Mirror therapy for patients with severe arm paresis after stroke - a randomized controlled trial. *Clinical Rehabilitation, 27*(4), 314-324. doi: 10.1177/0269215512455651

Thieme, H., Morkisch, N., Mehrholz, J., Pohl, M., Behrens, J., Borgetto, B., & Dohle, C. (2018). Mirror therapy for improving motor function after stroke (review). *Cochrane Database of Systematic Reviews, 7*. doi: 10.1002/14651858.CD008449.pub3

Vila Nova Mota, D., Ferreira de Meireles, A. L., Tavares Viana, M., & de Cássia de Albuquerque Almeida, R. (2016). Mirror therapy for upper limb rehabilitation in chronic patients after stroke. *Fisioterapia Em Movimento*, *29*(2), 287–293. https:/doi.org/10.1590/0103-5150.029.002.AO07

Wing Chiu Chan, & Au-Yeung, S. S. Y. (2018). Recovery in the Severely Impaired Arm Post-Stroke After Mirror Therapy: A Randomized Controlled Study. *American Journal of Physical Medicine & Rehabilitation*, *97*(8), 572–577.https://doi.org/10.1097/PHM.0000000000000919

Wu, C. Y., Huang, P. C., Chen, Y. T., Lin, K. C., & Yang, H. W. (2013). Effects of mirror therapy on motor and sensory recovery in chronic stroke: a randomized controlled trial. *Archives of Physical Medicine and Rehabilitation*, *94*(6), 1023-1030. doi: 10.1016/j.apmr.2013.02.007

Yavuzer, G., Selles, R., Sezer, N., Sütbeyaz, S., Bussmann, J. B., Köseoğlu, F., . . . Stam, H. J. (2008). Mirror Therapy Improves Hand Function in Subacute Stroke: A Randomized Controlled Trial. *Archives of Physical Medicine and Rehabilitation, 89*(3), 393-398. doi: 10.1016/j.apmr.2007.08.162

Yun, G. J., Chun, M. H., Parl, J. Y., & Kim, B. R. (2011). The synergic effects of mirror therapy and neuromuscular electrical stimulation for hand function in stroke patients. *Annals of Rehabilitation Medicine*, *35*, 316–21. doi: 10.5535/arm.2011.35.3.316

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Table 1. **List of Search Terms**

	Construct 1: Stroke		**Construct 2: Mirror therapy**		**Limits (if any)**
Database	**Subject Headings**	**Keywords**	**Subject Headings**	**Keywords**	
TRIP	N/A	"Stroke" OR "CVA" OR "cerebrovascular accident")	N/A	("Mirror therapy" OR "mirror box therapy" OR “mirror visual feedback”)	AND (“upper extremity” OR “upper extremity”) NOT (“phantom limb”)
CINAHL	(("Stroke") OR ("Stroke Patients"))	N/A	AND (("Mirror Therapy"))	N/A	
OT Search	N/A	("Stroke" OR "CVA" OR "cerebrovascular accident")	N/A	("Mirror therapy" OR "mirror box therapy" OR “mirror visual feedback”)	AND (“upper extremity”)
OTSeeker	N/A	((“Stroke”) OR (“CVA”) OR (“Cerebral Vascular Accident”)	N/A	AND (“Mirror”))	

PsycINFO	Cerebrovascular Accidents	N/A	Visual Feedback Rehabilitation	Mirror Therapy	
PubMed	Stroke	N/A	stroke rehabilitation	mirror	N/A
Note: [List here the peculiarities of each database that the person searching it should keep in mind. For example, how are subject heading searched or how to do a manual search] TRIP does not have subject headings. PsycInfo uses Index Terms as subject headings. OT Search uses “words and phrases” rather than keywords, avoid using subject headings as they are not clearly laid out on the website. OTSeeker does not have subject headings. CINHAL places the term MH before each subject heading when searching.					

Table 2. **Boolean Sentence for Each Database**

Database Name	**Boolean Sentence**
TRIP	***("Stroke"*** OR ***"CVA"*** OR ***"cerebrovascular accident")*** AND ***("Mirror therapy"*** OR ***"mirror box therapy"*** OR ***"mirror visual feedback")*** AND ***("upper extremity")***
CINAHL	((MH "***Stroke***") OR (MH "***Stroke Patients***")) AND ((MH "***Mirror Therapy***"))
OT Search	("***Stroke***" OR "***CVA***" OR "***cerebrovascular accident***") AND ("***Mirror therapy***" OR "***mirror box therapy***" OR "***mirror visual feedback***") AND ("***upper extremity***")
OT Seeker	(("***Stroke***") OR ("***CVA***") OR ("***Cerebral Vascular Accident***") AND ("***Mirror***"))
PsycINFO	{***Cerebrovascular Accidents***} AND {***Visual Feedback***} OR {***Mirror Therapy***} AND {***Rehabilitation***}
PubMed	((Stroke) OR "stroke rehabilitation") AND Mirror

Table 3. **Article Inclusion and Exclusion Criteria**

Inclusion Criteria			
Population	**Intervention and Comparison**	**Outcome**	**Other**
Adults: 18+	Mirror Therapy	Upper extremity	Quantitative-Controlled studies (Study Design)
			Peer-reviewed scholarly articles
Exclusion Criteria			
Population	**Intervention and Comparison**	**Outcome**	**Other**
	Intervention cannot be combined with another intervention i.e. mirror therapy & CIMT (unless results specific to mirror therapy can be extracted)		Studies in non-English language

Table 4. **Quality of Evidence Table**

	Citation	**Type of design**	**Quality Criteria 1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Quality Level**	**Evidence Level**
1	Amasalyi & Yaliman, 2016	RCT (3)	1	1	1	1	1	0	0	1	1	0	High	I
2	Guo, Qian, Wang & Xu, 2018	RCT (3)	1	1	1	1	1	1	N/A	1	0	0	High	I
3	Pérez-Cruzado, Merchán-Baeza, González-Sánchez, & Cuesta-Vargas, 2017	SR (4)	1	1	0	1	1	1	1	1	N/A	N/A	High	I
4	Thieme, Morkisch, Mehrholz, Pohl, Behrens, Borgetto & Dohle, 2018	SR (4)	1	0	1	1	1	1	1	1	N/A	N/A	High	I
5	Wing Chiu Chan & Au-Yeung, 2018	RCT (3)	1	1	1	1	1	1	N/A	1	1	1	High	I
6	Antoniotti et al., 2019	RCT (3)	1	1	1	1	1	1	N/A	0	0	0	Moderate	I
7	Cristina, Matei, Ignat, & Popescu, 2015	RCT (3)	1	1	1	1	0	1	N/A	1	0	0	Moderate	I
8	Ezendam, Bongers, & Jannink, 2009	SR (4)	1	0	0	1	0	1	0	1	N/A	N/A	Moderate	I
9	Ju & Yoon, 2018	Quasi (5)	0	1	1	1	0	0	1	0	0	1	Moderate	II
10	Lee, Hsieh, Wu, Lin & Chen, 2015	Quasi (5)	1	1	1	0	1	0	1	N/A	0	1	Moderate	II
11	Oliveira et al., 2019	RCT (3)	1	0	0	1	0	0	N/A	0	0	0	Low	I
12	Vila Nova Mota, Ferreira de Meireles, Tavares Viana, & Cassia de Alburquerque Almeida, 2016	Quasi (6)	0	1	1	0	1	0	0	0	N/A	N/A	Low	III

Table 5a. **Study description table: Systematic reviews**

Study	Design Type & Quality Level	Population (including age)	Intervention(s) Comparison(s) n in each group	Outcome (s)	Measurement Tools (unit; dir. of change)	Results (Effect Size (*d*))
Ezendam, D., Bongers, R. M. & Jannink, M. J. A. (2009)	Systematic Review Moderate	Dx: Stroke patients Age: 53-87	IG: MT n = 32 CG: Transparent plastic, exercise therapy n = 32 Stevens & Stoykov (2003) = 2 Rothgangel et al. (2004) = 16 Yavuzer et al.(2008) = 36	UE function	Qualitative 27 outcome measures were taken such as ROM, speed and accuracy, grip strength, and functional reach. 6 different standard functional scales were used to assess the severity of the motor deficit.	N.G. Not able to calculate due to primarily qualitative evidence
Pérez-Cruzado, Merchán-Baeza, González-Sánchez, & Cuesta-Vargas (2017)	Systematic Review High	Dx: Acute or chronic stroke and upper extremity impairment Age: Adults (18+)	IG: MT n = 241 CG: CT (OT, Mesh Glove, E-Stim, Therapeutic Activities, PT, Task-oriented functional practice) n = 307 Arya et al. (2015) n=33 Level I* Dohle et al. (2009) n=36 Level I Invernizzi et al. (2013) n=26 Level I Kim et al. (2014) n=27 Level I* Kojima et al. (2014) n=13 Level I* Lee et al. (2014) n=24 Level I Lee et al. (2012) n=28 Level I* Lin et al. (2014) n=43 Level I Michielsen et al. (2011) n=40 Level I Mirela Cristina et al. (2015) n=15 Level I Park et al. (2015) n=30 Level I	1. Motor recovery Arya et al., 2015 Kim et al., 2014 Kojima et al., 2014 Lee et al., 2014 Lee, 2012 Lin, 2014 Michielsen et al., 2011 Mirela Cristina et al., 2015 Park et al., 2015	N.G.	1.Inter: 0.98; Intra: 1.30 (Arya et al., 2015) Inter: 0.76; Intra: 0.77 (Kojima et al., 2014) Inter: 0.28; Intra: 0.57 (Lin, 2014) Inter: 0.49; Intra: 0.27 (Michielsen et al., 2011) Inter: -0.11; Intra: 1.55 (Mirela Cristina et al., 2015)

			Samuelkamaleshkumar et al. (2014) n=20 Level I	Samuelkamaleshkumar et al., 2014 2. UE Function Dohle et al., 2009 Invernizzi et al., 2013 Lee et al., 2012 Michielsen et al., 2011		Inter: 1.70; Intra: N.G. (Park et al., 2015) Inter: 1.12; Intra: 1.15 (Samuelkamaleshkumar et al., 2014) Inter: 0.58; Intra: 1.35 (Kim et al., 2014) Inter: 0.14; Intra: 0.43 (Lee et al., 2014) Inter: 0.76; Intra: 1.87 (Lee, 2012) 2.Inter: 0.7; Intra: 0.46 (Dohle et al., 2009) Inter: 0.77; Intra: 1.65 (Invernizzi et al., 2013) Inter: 0.61; Intra:1.65 (Lee et al.,, 2012) Inter: 0.25; Intra: 0.10 (Michielsen et al., 2011)

Thieme, Morkisch, Mehrholz, Pohl, Behrens, Borgetto, & Dohle (2018)	Systematic Review High	Dx: Stroke Age: 18+ Mean age of 59	IG: MT CG: Other interventions -62 total studies Total # of participants: n = 1982	1. UE function 2. Independence in ADLs	1. ARAT, WMFA, Manual Function Test, Motor Assessment Scale, Box and Block Test 2. FIM, Barthel Index	1. *d* = 0.46 [0.23, 0.69] -31 studies 2. *d* = 0.48 [0.30, 0.65] -19 studies

Table 5b. **Study description table: Group studies**

Study Citation	Design Type/ Level of Evidence/ Quality of Evidence	Population n per group	Intervention & Comparison Group	Outcomes Measured	Outcome Measures	Mean (SD or CI) or Mean - SE	Inferential Statistics	Effect Size
Amasyali & Yaliman (2016)	RCT Level I High	Dx: Ischemic stroke past 12 months Age: 20-85 Subjects I/C: n=7/7	IG:MT + CT CG: CT	1. UE Function	1. FMA a. FM-UE b. FM-SEF c. FM-wrist	a. IG: pre: 36.55 (17.80) post:48.66 (15.50) f/u: 56.14 (11.24) CG: pre: 39.87 (17.74) post: 45.62 (17.11) f/u: 51.42 (15.20) b. IG: pre: 21.00 (9.89) post: 26.67 (8.58) f/u: 30.00 (5.85) CG: pre: 23.00 (10.30) post: 25.13	a. Pre to post: p<0.05 (between groups) b. Pre to post: N.S. c. Pre to post: N.S.	a.MDD= 8.87<12.11* b. MDD= 5.15<5.67* c. MDD= 1.55<2.23*

					d. FM-hand e. FM-coordination	(8.45) f/u: 28.29 (7.15) c. IG: pre: 4.33 (3.64) post: 6.56 (3.50) f/u: 8.86 (2.19) CG: pre: 5.25 (3.10) post: 6.38 (3.37) f/u: 7.71 (2.81) d. IG: pre: 7.78 (4.57) post: 11.00 (3.50) f/u: 12.43 (3.30) CG: pre: 8.00 (5.42) post: 9.75 (5.77) f/u: 10.71 (5.31) e.	d. Pre to post: N.S. e. Pre to post: N.S.	d. MDD= 2.71<3.22 * e. MDD= 0.53<1*

						IG: pre: 3.44 (1.66) post: 4.44 (0.88) f/u: 4.86 (0.90) CG: pre: 3.63 (1.06) post: 4.38 (1.18) f/u: 4.71 (1.11)		
Antoniotti et al. (2019)	RCT Level I Moderate	Dx: Stroke; acute (within 4 weeks of CVA) Age: 18-80; I/C means= 68.2/69.5 Subjects I/C n= 16/19	IG: MT + physiotherapy + OT CG: Sham therapy+ physiotherapy + OT	1.UE Function	1. FMA	1.IG: pre: 28.5 (21.8) post: 38.3 (23.4) CG: pre: 30.9 (23.9) post: 40.6 (21.3)	IG: 12.2 (7.2 to 17.3) CG: 10.2 (5.4 to 15.0)*	1.N.G. MCID = 10 points IG: 9.8 CG: 9.7
Cristina, Matei, Ignat, & Popescu (2015)	RCT Level I Moderate	Dx: Subacute ischemic stroke symptoms & UE hemiparesis	IG: MT + neurorehabilitation techniques/E-stim/ OT CG: Neurorehabilitation techniques/E-stim/	1. Motor Recovery	1. Brunnstrom Stage	1. IG: Pre: 3.16 (0.71) Post: 4.52 (0.54) CG: Pre: 3.28	1. IG: 0.005 CG: 0.05	1. MDD= .375 < 1.36 *

		Age: 56-68 Subjects I/C: n= 7/8	OT	2. UE Function 3. Finger Flexion (UE Function)	2. FMA 3. Bhakta Test	(0.75) Post: 4.33 (0.89) 2. IG: Pre: 3.41 (8.4) Post: 46.5 (7.5) CG: Pre: 38.6 (6.2) Post: 47.3 (6.3) 3. IG: Pre: 3.44 (0.52) Post: 3.88 (0.33) CG: Pre: 3.22 (0.19) Post: 3.55 (0.52)	2. IG: 0.01 CG: 0.04 3. IG: 0.04 CG: N.S.	2. MDD= 3.1 < 43.09* 3. MDD= 0.095 < .44 *
Guo, Qian, Wang & Xu (2018)	RCT: 3 Level 1 High quality	Dx: Post-Stroke Age: 34-75 n=120 groups: IG: n=30 CG1: n=30 CG2: n=30 CG3: n=30	IG: MT CG1: ESWT CG2: MT + ESWT CG3: CT	UE function	FMA	IG: Pre: 12.86 (2.89) 1 month: 15.98 (3.67) 3 months:18.62 (2.91) 6 months: 19.74 (1.97)	*P<0.05 1 month: IG vs CG2, IG vs CG3, CG1 vs CG2 3 months: IG vs CG3 6 months: IG vs CG3 12 months: IG vs CG1 **P<0.01	1. Effect size N.G. MCID = 10 points -IG → 9.37 -CG1 →10.92* -CG2 → 17.1* -CG3 → 7.1

						12 months: 22.23 (2.12) CG1: Pre: 13.06 (3.01) 1 month: 16.53 (4.13) 3 months: 19.08 (3.96) 6 months: 20.12 (2.21) 12 months: 23.98 (2.91) CG2: Pre: 12.63 (2.08) 1 month: 17.87 (3.91) 3 months: 22.13 (3.15) 6 months: 25.82 (3.18) 12 months: 29.73 (2.35) CG3: Pre: 12.36 (2.38) 1 month: 14.16 (4.23)	1 month: CG1 vs CG3 3 months: IG vs CG2, CG1 vs CG2 ***P<0.001 1 month: CG2 vs CG3 3 months: CG1 vs CG3, CG2 vs CG3 6 months: IG vs CG2, CG1 vs CG2, CG1 vs CG3, CG2 vs CG3 12 months: IG vs CG2, IG vs CG3, CG1 vs CG2, CG1 vs CG3, CG2 vs CG3	

						3 months: 17.23 (3.91) 6 months: 18.19 (3.32) 12 months: 19.46 (2.87)		
Ju & Yoon (2018)	Quasi Experimental Level II Moderate	Dx: Acute Stroke Age: 61.3 +/- 11.2 Subjects: I/C n= 14/14	IG: MT + ADL training and self-exercise CG: Modified CIMT + ADL training and self-exercise	1.UE Function 2. Independence in ADLs	1. Manual Function Test (MFT) (Scored from 0-32) 2. Korean Version of Modified Barthel Index (K-MBI)	Hygiene: mCIMT: r= 0.60 Mirror Therapy: r=-0.22 Bathing mCIMT: r= -0.29 Mirror Therapy: r=-0.11 Feeding: mCIMT: r= 0.76 Mirror Therapy:r= -0.18 Toilet:	1. MT: little to no mCIMT: moderate to good 2. MT: little to no mCIMT: fair 3. MT: little to no mCIMT: good to excellent 4. MT: fair mCIMT: fair 5. MT: fair	1. N.G. Unable to calculate 2. N.G. Unable to calculate 3. N.G. Unable to calculate 4. N.G. Unable to calculate 5. N.G. Unable to calculate

						mCIMT: r= 0.28 Mirror Therapy: r= 0.31 Dressing: mCIMT: r=0.56 Mirror Therapy: r=-0.33	mCIMT: moderate to good	
Lee et al. (2015)	Quasi-Experimental Level II High	DX: First chronic unilateral stroke >6 mo. Age: 53.42-55.71 Subjects I/C: n= 64/54/56	IG: MT CG1: Robot-Assisted Therapy CG2: CIMT	1. UE Recovery 2. UE function	1. UE-FMA 2. ARAT	1. NG 2. NG	1. IG: 0.001 CG1:NG CG2: <.001 2. IG: 0.04 CG1: NG CG2: 0.01	1. MCID= 21 & 35 (responders/non-responders) 2. N.G. Unable to calculate
Oliveira et al. (2019)	RCT Level 1 Low	Dx: Post-Stroke Age: 45-75 Subjects -	IG: MT CG1: CT CG2: Vibration Therapy	1.UE Function	1a.WMFT (Time)	1a. IG Pre: 22.5 Post: 15.4 CG1:	1a. IG (p=0.002) CG2 (p=0.001)	Effect size N.G. 1a. MDC: 0.7 sec -IG: 22.5-15.4=7.1* -CG2: 21.2-15.4 =

		n=7/7/7=21		 2. UE Mobility (UE Function)	 1b. WMFT (Function) 2. Rivermead Mobility Index	Pre: 22.4 Post: 22.6 CG2: Pre: 21.2 Post: 15.4 1b. IG: Pre: 1.7 Post: 3.8 CG1: Pre: 1.8 Post: 1.9 CG2: Pre: 1.8 Post: 3.7 2. IG: Pre: 8.9 Post: 13.3 CG1: Pre:10.1 Post: 10.6 CG2: Pre: 10 Post:13.7 3. IG:	 1b. IG (p =0.002) CG2 (p=0.003) 2. IG (p =0.003) CG2 (p = 0.002) 3.	5.8 1b. MDC: 0.1 pts -IG: 3.8-1.7=2.1* -CG2: 3.7-1.8=1.9 2. MDC: 2.2 pts -IG: 13.3- 8.9=4.4* -CG2: 13.7-10= 3.7

				3.Manual Function (UE Function)	3.Jebsen Taylor Test	Pre: 24.6 Post: 18.1 CG1: Pre: 26.1 Post: 25.6 CG2: Pre: 25.6 Post: 18.7	IG (p =0.002) CG2 (p=0.001)	3. N.G.
Vila Nova Mota, Ferreira de Meireles, Tavares Viana, & de Cassia de Alburquerque (2016)	Quasi-Experimental: Single group Level III Low	DX: Chronic Stroke with UE hemiplegia Ages: 47±15 n = 10	IG: MT	1. UE Function	1.. FMA	1. Pre: 49- 5.6 Post: 53.5- 5.3	1. N.S.	1. 14.7 (N.S.)
Wing Chiu Chan & Au-Yeung (2018)	RCT Level 1 High	Dx: ≤ 1 month post-stroke Age: 50-77 Subjects - I/C n= 15/20	IG: MT CG: CT	1.UE Function 2. UE Mobility (UE Function)	1. FMA 2. WMFT (Time)	1. IG: Pre: 19.2(16.0) Post:34.4(18.9) CG: Pre: 21.7(5) Post: 38.0(18.2) 2. IG: Pre: 92.2(37.8) Post:61.7(44.9) CG: Pre: 77.6(39.2)	1.IG: *p* = 0.001 CG: *p* < 0.001 Group: *p* = 0.867 2.IG: *p* = 0.002 CG: *p* = 0.001 Group: *p* = 0.947	1. MDC: 7.55 pts -IG: 34.4-19.2=15.2* -CG: 38.0-21.7=16.3 2. MDC: -19.6 sec -IG: 61.7-92.2=-30.5* -CG: 49.4-77.6= -28.2

				3.Manual Function (UE Function)	3. WMFT (Function)	Post: 49.4(39.2) 3. IG: Pre: 1.4(0.6) Post:2.5(1.4) CG: Pre: 1.8(0.7) Post: 2.8(1.4)	3.IG: p = 0.009 CG: p = 0.001 Group: p = 0.676	3. MDC: 0.35 pts -CG: 2.8-1.8=1.0 -IG: 2.5-1.4=1.1*

Key			
ADLs	Activities of Daily Living	IG	Intervention Group
ARAT	Action Research Arm Test	MCID	Minimal Clinically Important Difference
CG	Comparison Group	MDC	Minimal Detectable Change
CIMT	Constraint Induced Movement Therapy	MDD	Minimal Detectable Difference
CT	Conventional Therapy	MT	Mirror Therapy
Dx	Diagnosis	N.G.	Not Given

ESWT	Extracorporeal Shock Wave Therapy	UE	Upper Extremity
FIM	Functional Independence Measure	WMFT	Wolf Motor Function Test
FMA	Fugl Meyer Assessment	*	Clinically Significant

Figure 1. Flowchart