Chapter 7

Effectiveness of mirror therapy by Fugl-Meyer scale in stroke: review with meta-analysis

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ABSTRACT
Objective: To review in the literature the effectiveness of Mirror Therapy (MT) compared to the various types of Control Groups (CGs) by the Fugl-Meyer Scale (FMS) in patients with stroke. Method: a systematic review was performed with meta-analysis of randomized controlled trials in the LILACS, MEDLINE, Cochrane Library and PEDro databases (2008-2018). Controlled studies of patients with strokes who underwent treatment with TM were included and excluded animal studies, incompatible subjects, incomplete data, case studies and absence of total FMS scores (upper and lower extremities). Results: The search resulted in 193 studies and, after the selective steps, nine articles remained; of these, eight analyzed the upper extremity and one lower extremity. All studies analyzed together showed high heterogeneity and, when investigated in dissociation, such fact did not occur. The data did not show significant differences between the comparison of MT and CGs, when FMS was used by the global evaluation of the members (95% CI: -0.59 to 0.88) and the separate evaluation of the upper extremity (95% CI: -0.96 to 0.53). The lower extremity in relation to the CGs showed significant results. Conclusion: There is a lack of clear evidence to support the superiority of the MT by the analysis of the FMS before the CGs.

Keywords: Mirror Therapy, stroke and Fugl-Meyer Scale.

1 INTRODUCTION

Stroke is classically characterized as a neurological deficit attributed to an acute focal injury to the central nervous system from a vascular cause including infarction, intracerebral hemorrhage, and subarachnoid hemorrhage, and is one of the leading causes of death and disability in the world[1] . Although most survivors recover to some degree, motor impairments will commonly affect them for the rest of their lives .[2]

The disabilities resulting from post-CVA are a great challenge not only for the patients and their families, but also for the health care units, generating significant costly charges[3] . In Brazil, it has been estimated the prevalence of 2,231,000 people with CVA and 568,000 with severe disability as a result. The point prevalence is 1.6% in men and 1.4% in women, and the disability prevalence is 29.5% in men and 21.5% in women .[4]

The main sequelae of this pathology are hemiplegia or hemiparesis, spasticity, decreased muscle strength, motor function, and sensitivity. The motor deficits are present in 55% to 75% of the individuals associated with a relevant decrease in quality of life. In addition, 32% of patients present intense alterations in their functional capacities[5] .

Numerous physiotherapeutic treatments have been successful in alleviating the ilations of this disease, such as biofeedback[6] , cross-education[7] , virtual reality[8] , hydrotherapy[9] ; neurodevelopmental treatment-Bobath, proprioceptive neuromuscular facilitation[10] , resistance exercises[11] and Mirror Therapy[12].

This last therapeutic modality has its mechanism based on the concept of visual illusion, in which the movement of the non-paretic limb performed in front of the mirror (reflective side) is perceived as performed by the paretic side (hidden next to the mirror). This therapy allows the individual to experience normal movement, even if the limb is severely paralyzed[13] . The illusory perception of movement generates a neuropsychological phenomenon that can induce neural activation of the injured brain and enhance recovery by neuroplasticity of sensory-motor activity . [14]

In recent years, numerous scales have been used to assess the sensory-motor status after a stroke. The functional assessment scales are commonly used in research with the purpose of making diagnoses, prognoses and responses to treatments[15] . They commonly focus on the independence in daily life or functional activities, such as the Barthel Index or the Rankin Scale, however, they are not specific to measure the impairment in sensory-motor function arising from hemorrhagic or ischemic insults from a stroke[15,16] .

There is a resource that is designed specifically to assess the hemiplegic patient's recovery, the Fugl-Meyer Scale. It is divided into five domains: motor function, sensitivity, balance, range of motion, and pain. The motor function domain includes measurement of movement, coordination, and reflex activity of the shoulder, elbow, wrist, hand, hip, and ankle, totaling 100 points, 66 for the upper extremity and 34 for the lower extremity. Depending on the total score, the patient can be classified as having severe, moderate, or mild impairment. This evaluation method has had its reliability and validity confirmed for the evaluation of changes in the clinical picture of this type of patient[15, 17] .

The purpose of this article was to verify the effectiveness of Mirror Therapy by analyzing the total scores of the body extremities together and separately by the Fugl-Meyer Scale in stroke patients, through a systematic review with subsequent meta-analysis, since the scientific literature has not explored the intelection of data from this scale in the last ten years.

2 METHODS

To prepare this systematic review with meta-analysis, the question "Can the effectiveness of Mirror Therapy be attested and ratified by the total scores of the body extremities together and separately by the

Fugl Meyer Scale in stroke patients? This question was formulated using the *Population, Intervention, Comparison, Outcome* (PICO) strategy for constructing the research question and searching for evidence[18].

It is irrefutable that systematic reviews with meta-analyses are based on insightful questions and make use of systematized methods to identify, select, and critically evaluate relevant research. Furthermore, to increase the methodological rigor of this article, the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) guidelines were used, whose main objective is to assist authors in producing high-quality content and scientific evidence[19] .

2.1 BIBLIOGRAPHIC SEARCH TACTICS OF CLINICAL TRIALS

A priori a systematic review was conducted to search for the articles in the following databases*:* Cochrane Library, Latin American and Caribbean Literature in Health Sciences (LILACS), MEDLINE (via PubMed) and *Physiotherapy Evidence Database (*PEDro). Articles were refined in each search portal by year of publication (2008-2018). Furthermore, it should be noted that the selection of publications ended in 2018.

In addition, a tactic was adopted to filter the crossing of the two descriptors or keywords with a specific Boolean operator in the databases, to restrict pretermitted sources. *Mirror therapy*" and "Fugl-Meyer" concatenated by the "*and*" operator were used. The articles were selected in five stages:

Stage 1: Selection of all potentially relevant articles in the databases;

Stage 2: Exclusion of repeated articles;

Stage 3: Reading of the titles and abstracts found and application of the exclusion and inclusion criteria;

Stage 4: Full reading of all the remaining studies from the previous stages and selection of those that fit the inclusion criteria and ascertainment of the presence of the Fugl-Meyer Scale total scores; Fugl-Meyer for upper extremity or Fugl-Meyer for lower extremity.

Stage 5: Incorporation of the clinical trials to perform the statistics.

2.2 ELIGIBILITY CRITERIA

Randomized, controlled, clinical trials with adult patients (aged 18 years and older) with stroke, undergoing Mirror Therapy that have used the Fugl-Meyer Scale as one of the forms of function assessment in the English language only were included.

2.3 EXCLUSION CRITERIA

Experimental studies with animals, with other techniques related to Mirror Therapy, with incomplete data and without full scale scores, subject matters incompatible with the proposal, case studies, systematic reviews and meta-analyses were removed.

2.4 RISK ASSESSMENT OF STUDY BIAS

To assess the risks of bias in randomized clinical trials, the *Cochrane Collaboration* criteria for the development of systematic intervention reviews were analyzed, which classifies the risks into uncertain, low and high, according to the following domains: randomization sequence generation, allocation concealment, blinding of participants and professionals, blinding of outcome assessors, blinding of outcome assessors and reporting of selective outcome, and other sources of bias[20] .

3 STATISTICAL REGISTRATION AND ANALYSIS

The data from these articles were stored and thoroughly analyzed by means of a protocol file created using the *Microsoft Office Excel* application (2013). Spreadsheets were created with the names of each database and the following points were inserted and observed: title of the article, name(s) of the author(s), year of publication, population/sample, mean of the final outcomes Fugl-Meyer Scale of the Mirror Therapy group and Control Groups and their respective standard deviations. Even though they were present in some studies, *follow-up* data was not used, as a way to homogenize and avoid possible biases in the statistical analysis, emphasizing the immediate effect after the end of treatment.

To perform the meta-analysis, the inverse variance statistical method was used, associated with a fixed effect model for the comparison between Mirror Therapy and the control group, always the last evaluations recorded with the scale mentioned before, considering a significance value $\alpha \leq 0.05$. Added to this, the statistical heterogeneity of the treatment effect was also evaluated using Cochrane's Q test and the I^2 inconsistency test, so that 0% indicates no heterogeneity, close to 25% indicates low heterogeneity, close to 50% indicates moderate heterogeneity, and close to 75% indicates high heterogeneity between studies. These analyses were performed in the Review Manager software version 5.3 (*Cochrane Collaboration*).

4 RESULTS

The tactic of bibliographic search of clinical trials, in the 1st stage, resulted in 193 potentially relevant studies; in the 2nd stage, 91 were excluded for being duplicates; in the 3rd stage 78 were removed, after the intelection of titles, abstracts and application of the inclusion-exclusion criteria; in the 4th stage 6 were excluded for presenting only sub-scores of the Fugl-Meyer Scale; 1 clinical trial in a language other than English, 6 eliminated for presenting *crossover of* the ET with another technique, 2 did not present data expressed in mean (only confidence interval); the last stage generated 9 articles that fulfilled all the study requirements (Figure 1). The characterization of the clinical trials is shown in Table 1 and summarizes the main characteristics of the studies.

The groups that performed the ET had a total of 129 patients; of these, 118 participated in the upper extremity and 11 in the lower extremity. The CG had a total of 131 patients, of which 120 were investigated in the upper extremity and 11 in the lower extremity. All this demonstrates that there was equity in the formation of the groupings of clinical trials.

When analyzing the meta-analysis of the effectiveness of ET versus CG by the EFM of the extremities together, it was found that there are no differences between the two groups (95% CI: -0.59 to 0.88) with p = 0.70, and they show a great heterogeneity between the studies (I^2: 70%). When such body segments were evaluated separately, the non-heterogeneity of the studies was observed regarding the upper extremity (I^2: 0%), also showing a trend in favor of the group that performed Mirror Therapy, although this did not reverse into a significant difference (p = 0.57). As for the lower extremity, the heterogeneity could not be confirmed, since only one study was included, according to the criteria of the systematic review, and it revealed that the control group obtained better results in this respect (95% CI: 4.49 to 11.51) with a significant value of $p < 0.05$ - not ratifying the supremacy of the use of the mirror as a therapeutic form (Figure 2).

The risks of bias were also investigated in a qualitative manner. It was found that most articles presented themselves adequately and intelligibly in the randomization process, in the blinding of the evaluators, and in the description of the selective outcome reports, and the data proposed to be evaluated were not missing. In contrast, double-blinding was not present in any of the papers, and concealment of group allocation was absent in 8 of the 9 papers (Figure 2).

5 DISCUSSION

This study revealed evidence that the ET treatment does not show greater effectiveness in upper and lower limb rehabilitation in post-stroke patients, when comparing this therapeutic form with CG by the Fugl-Meyer Scale.

All the CG described here performed some form of physiotherapeutic intervention, such as conventional therapy[21,22,23,24] , passive mobilization[13] , active exercises without using the mirror[25] , simulated Mirror Therapy and electrotherapy[26] ; bimanual exercises observing both hands[27] and simulated Mirror Therapy with a non-reflective surface[28] . It is established in the literature that the presence of any form of physical therapy treatment brings some benefits to post-stroke patients[29.] This ratifies the effectiveness of these forms and can equate them to the positive effects of ET.

The ET is one of the most widespread techniques used in clinical practice, and has been the target of constant verification of its effectiveness. A systematic review conducted during the period from 2009 to 2015 inferred a better performance of ET for the upper limb when compared to conventional therapy[30] . This work clashes with the results expressed here, due to the fact that it is generalist in the tests considered for verification, for not considering other forms of control and not performing a meta-analysis of its data.

Another study with greater methodological rigor carried out a systematic review with meta-analysis and conjectured that the use of ET seems to be promising in some areas of lower limb function, although it points out that there is not enough evidence to suggest when and how to approach this therapy[31] . This scientific study considered positive results by virtue of the analysis of the inverse statistics of Fugl-Meyer scales and Brunnstrom stages simultaneously, a fact that may generate a beneficial trend in favor of ET.

Another systematic review, which aimed to verify the benefits of improving motor function of the paretic lower limb, corroborated the current study when it also pondered that it could not have a firm conclusion on the effectiveness of Mirror Therapy[32] .

In work conducted by Toh and Fong (2012) on the effectiveness of upper limb ET, it made it clear that more research is needed to determine the optimal dose of therapy, optimal time to start this intervention, and the right target group. And that no firm conclusions could be drawn at that time about the effectiveness of TM until more evidence was present.

The weakness found in all the studies entered, in relation to the *design of* the randomized controlled trials, lay in the failure to perform double-blinding, which, according to Michielsen *et al*. (2011), is justified by the nature of this therapy employed.

6 CONCLUSION

This systematic review with meta-analysis suggests that there is a lack of clear evidence supporting the superiority of ET by Fugl-Meyer Scale analysis over the various types of controls. It also opens doors for new studies that can evaluate such a scale in Control Groups with a specific profile.

6.1 STRENGTHS, LIMITATIONS OF THE REVIEW, AND FINAL CONSIDERATIONS

The strengths of this article lie in the adoption of established protocols, standards, and guidelines for the formulation of systematic reviews, such as PRISMA, PICO, and Cochrane. All of this gives it a strong methodological rigor, minimizing possible selection bias. In addition, continuous *feedback* was created in the fifth stage of selection about the inclusion and exclusion criteria, in order to try to further mitigate the chance of this problem appearing.

More studies should be conducted, aiming to elucidate further the efficiency of this technique, with specific scales and in larger databases, because the study shows a tendency to improve motor function for the paretic limb and incites the production of more clinical trials to ratify or refute such a bias.

Figure 1 - Flowchart of the included studies.

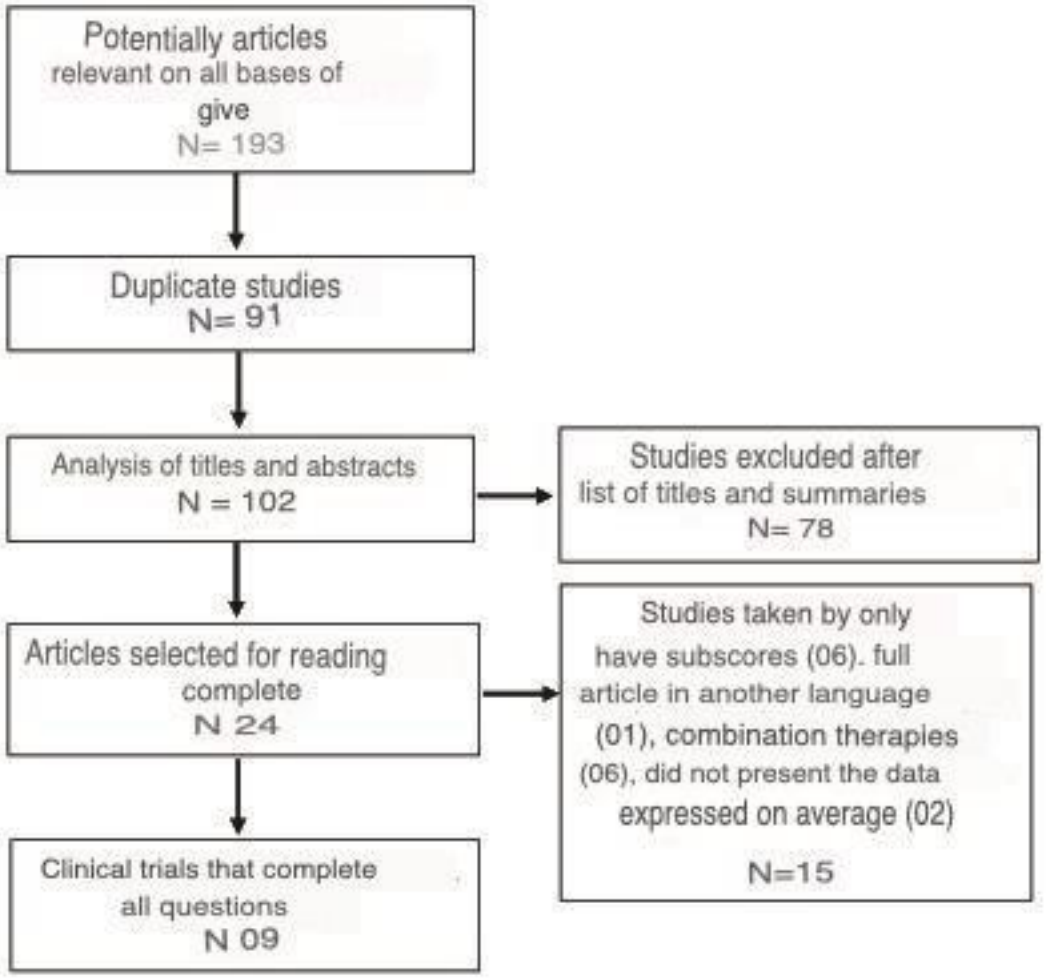


Figure 2 - Analysis of the comparison between Mirror Therapy and the Control Group.
SD: Standard Deviation; CI: Confidence Interval; I²: Inconsistency Test; P: p Value; df: Degrees of Freedom

	Terapia do Espelho			Grupos Controle				Mean Difference
Study or Subgroup	**Mean**	**SD**	**Total**	**Mean**	**SD**	**Total**	**Weight**	**IV, Fixed, 95% CI**
1.1.1 Extremidade superior								
Amasyali e Yaliman (2016)	48.66	15.5	9	45.62	17.11	8	0.2%	3.04 [-12.55, 18.63]
Chan e Au-Yeung (2018)	34.4	18.9	20	38	18.2	21	0.4%	-3.60 [-14.97, 7.77]
Colomer et al. (2016)	9.1	1.1	15	9.5	1.1	16	89.4%	-0.40 [-1.17, 0.37]
Cristina et al. (2015)	46.5	7.5	7	47.3	6.3	8	1.1%	-0.80 [-7.87, 6.27]
Lee et al. (2015)	46.88	9.96	17	43.56	8.73	16	1.3%	3.32 [-3.06, 9.70]
Lin et al. (2014)	49.86	8.97	14	47.13	10.12	14	1.1%	2.73 [-4.35, 9.81]
Michielsen et al. (2011)	43.5	14	20	36.4	14.7	20	0.7%	7.10 [-1.80, 16.00]
Wu et al. (2013)	51.25	8.14	16	47.88	9.75	17	1.4%	3.37 [-2.74, 9.48]
Subtotal (95% CI)			**118**			**120**	**95.6%**	**-0.21 [-0.96, 0.53]**
Heterogeneity: Chi² = 6.51, df = 7 (P = 0.48); I² = 0%								
Test for overall effect: Z = 0.56 (P = 0.57)								
1.1.2 Extremidade inferior								
Mohan et al. (2013)	25.36	2.25	11	17.36	5.5	11	4.4%	8.00 [4.49, 11.51]
Subtotal (95% CI)			**11**			**11**	**4.4%**	**8.00 [4.49, 11.51]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 4.47 (P < 0.00001)								
Total (95% CI)			**129**			**131**	**100.0%**	**0.14 [-0.59, 0.88]**
Heterogeneity: Chi² = 26.62, df = 8 (P = 0.0008); I² = 70%								
Test for overall effect: Z = 0.38 (P = 0.70)								
Test for subgroup differences: Chi² = 20.10, df = 1 (P < 0.00001), I² = 95.0%								

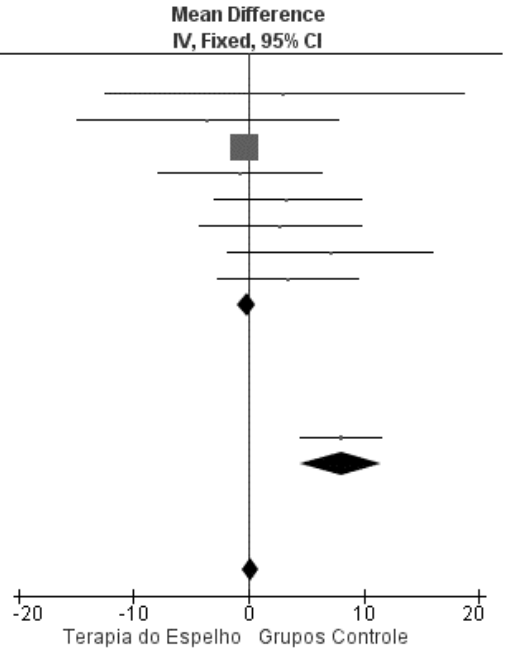


Table 1 - General characteristics of the included studies

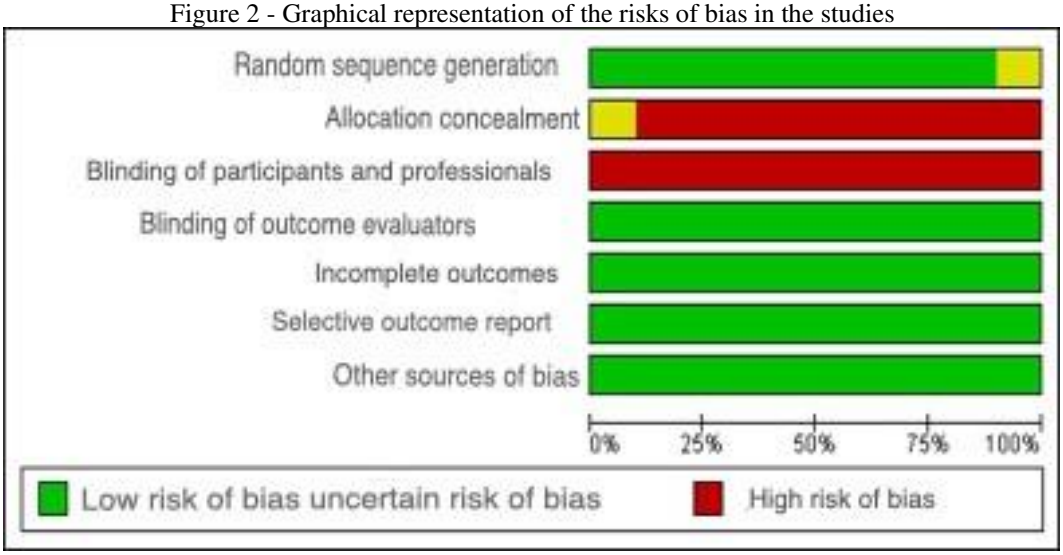
Authors (year)	Sample	Therapy time	Forms of Evaluation	Purpose of the study	Main Results and Conclusion
Michielsen et al. (2011)	TE: 20 patients CG: 20 patients	6 months 5 days/week 1 hour/day	Fugl-Meyer Scale for upper extremity, pain spasticity, grip strength, Functional MRI, daily hand use and quality of life.	To evaluate the effects of Mirror Therapy and cortical reorganization in patients with moderate spasticity.	Mirror Therapy showed effectiveness in chronic stroke and cortical reorganization was evidenced.
Wu et al. (2013)	TE: 16 patients CG: 17 patients	4 weeks 5 days/week 1.5 hours/day	Fugl-Meyer lower extremity scale, kinematic analysis, Nottingham Revised Sensory Evaluation, Motor Activity Record, and Abilhand Questionnaire.	Compare the effects of mirror therapy *versus* control treatment (traditional physical therapy) on movement achievement, motor control, sensory recovery, and performance of activities of living.	Beneficial effects were found in movement performance, motor control, and thermal sensation. Although there are such positive points, this does not translate into improved daily functions.
Mohan et al. (2013)	TE: 11 patients CG: 11 patients	2 weeks 6 days/week 1 hour/day	Fugl Meyer lower extremity scale, Brunnel Balance Assessment, Functional Environment Categories.	To evaluate the effectiveness of mirror therapy on lower limb motor recovery, balance and mobility.	Mirror therapy soon after stroke is not superior to conventional treatment in improving lower limb motor recovery and balance, except for improved mobility.
Lin et al. (2014)	TE: 42 patients CG: 42 patients TE + LM: 42 patients	4 weeks 5 days/week 1.5 hours/day	Fugl-Meyer upper extremity scale, muscle tone by Myoton-3, box and block test, walking test, Motor Activity Record, and Abilhand Questionnaire.	Demonstrate the comparison of the effects of TE, TE and LM, CG on the outcomes of motor impairments, manual dexterity, ambulation function, motor control, and daily function.	TE + LM improved manual dexterity and ambulation. TE + LM and TE reduced motor impairment and synergistic shoulder abduction more than CG.
Cristina et al. (2015)	TE: 7 patients CG: 8 patients	6 weeks 5 days/week 30 min/day	Brunnstrom's recovery stage, Fugl-Meyer for	To evaluate the effects of mirror therapy program and physical therapy	Mirror Therapy can improve

			upper extremity, Ashworth Scale, Bhakta Test.	methods on upper limb recovery.	motor recovery in upper limbs of stroke patients.

Table 1 – Continuation

Authors (year)	Sample	Therapy time	Forms of Evaluation	Purpose of the Study	Main Results and Conclusion
Lee et al. (2015)	TE: 42 patients CG: 42 patients TE + LM: 42 patients	4 weeks 5 days/week 1.5 hours/day	Fugl-Meyer for upper extremity, Muscle properties (tone, stiffness), sensory-motor measures and daily functions.	Determine effects of the TE + LM approach on muscle properties, sensorimotor functions, and daily function.	No significant differences were found between groups on the Fugl-Meyer Assessment, TE + LM induced distinctive effects on muscle properties, manual dexterity and daily function.
Amasyali and Yaliman (2016)	TE: 9 patients ES: 7 patients CG: 8 patients	3 weeks 5 days/week 30 minutes/day	Fugl-Meyer for upper extremity, grip strength and wrist extension.	To evaluate the effectiveness of mirror therapy and neuromuscular stimulation therapy triggered by electromyography in improving upper extremity function in stroke patients compared to conventional therapy, as well as to assess the advantage of each treatment over the other.	TE was more effective in improving motor performance than physical therapy alone. In addition, TE may be more useful in improving hand skills compared to neuromuscular stimulation with EMG.
Colomer et al. (2016)	TE: 15 patients CG: 16 patients	8 weeks 3 days/week 45 minutes/day	Wolf's motor function test, Fugl-Meyer for upper extremity and Nottingham sensory evaluation.	To determine the effectiveness of Mirror Therapy in chronic stroke survivors with severe disability and comparison with passive mobilization.	Compared to passive mobilization, TE in chronic stroke survivors in severely compromised upper limb may provide a limited but positive effect on light touch sensitivity while providing similar motor improvement.
Chan and Au-Yeung (2018)	TE: 20 patients CG: 21 patients	4 weeks 2 days/week 30 min/day	Fugl-Meyer for upper extremity, Wolf's Motor Function Test.	To examine the effectiveness of mirror therapy in the recovery of the severely compromised arm after stroke.	TE or CG (which involved exercises concurrently for the paretic and unaffected arms during the subacute stroke) promoted similar motor recovery in the impaired arm.

Figure 2 - Graphical representation of the risks of bias in the studies



REFERENCES

1. Sacco RL, Kasner SE, Broderick JP, Caplan LR, Connors JJ, Culebras A, et al. An updated definition of stroke for the 21st century: a statement for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2013; 44(7): 2064-2089.

2. Katoozian L, Tahan N, Zoghi M, Bakhshayesh B. The Onset and Frequency of Spasticity After First Ever Stroke. J Natl Med Assoc. 2018; 110(6): 547-552.

3. Oyewole OO, Ogunlana MO, Oritogun KS, Gbiri CA. Post-stroke disability and its predictors among Nigerian stroke survivors. Disabil Health J. 2016; 9(4): 616-623.

4. Bensenor IM, Goulart AC, Szwarcwald CL, Vieira ML, Malta, DC, Lotufo PA. Prevalence of stroke and associated disability in Brazil: National Health Survey – 2013. Arq Neuro-Psiquiatr. 2015; 73(9): 746-750.
5. Carregosa AA, Aguiar Dos Santos LR, Masruha MR, Coelho MLDS, Machado TC, Souza DCB et al. Virtual Rehabilitation through Nintendo Wii in Poststroke Patients: Follow-Up. J Stroke Cerebrovasc Dis. 2018; 27(2): 494-498.

6. Stanton R, Ada L, Dean CM, Preston E. Biofeedback improves performance in lower limb activities more than usual therapy in people following stroke: a systematic review. J Physiother. 2017; 63(1): 11-16.
7. Ehrensberger M, Simpson D, Broderick P, Monaghan K. Cross-education of strength has a positive impact on post-stroke rehabilitation: a systematic literature review. Top Stroke Rehabil. 2016; 23(2): 126-135.

8. Pedreira da Fonseca E, Ribeiro da Silva NM, Pinto EB. Therapeutic Effect of Virtual Reality on Post-Stroke Patients: Randomized Clinical Trial. J Stroke Cerebrovasc Dis. 2017; 26(1): 94-100.

9. Zhang Y, Roxburgh R, Huang L, Parsons J, Davies TC. The effect of hydrotherapy treatment on gait characteristics of hereditary spastic paraparesis patients. Gait Posture. 2014; 39(4): 1074-1079.

10. Krukowska J, Bugajski M, Sienkiewicz M, Czernicki J. The influence of NDT-Bobath and PNF methods on the field support and total path length measure foot pressure (COP) in patients after stroke. Neurol Neurochir Pol. 2016, 50(6): 449-454.

11. Ivey FM, Prior SJ, Hafer-Macko CE, Katzel LI, Macko RF, Ryan AS. Strength Training for Skeletal Muscle Endurance after Stroke. J Stroke Cerebrovasc Dis. 2017; 26(4): 787-794.

12. KIM MK, JI SG, CHA HG. The effect of mirror therapy on balance ability of subacute stroke patients. Hong Kong Physiotherapy Journal. 2016; 34: 27-32.

13. Colomer C, NOé E, Llorens R. Mirror therapy in chronic stroke survivors with severely impaired upper limb function: a randomized controlled trial. Eur J Phys Rehabil Med. 2016; 52(3): 271-278.

14. Arya KN, Pandian S1, Kumar V. Effect of activity-based mirror therapy on lower limb motor-recovery and gait in stroke: A randomised controlled trial. Neuropsychol Rehabil. 2017; 26:1-18.

15. Maki T, Quagliato EMAB, Cacho EWA, Paz LPS, Nascimento NH, Inoue MMEA et al. Reliability study on the application of the Fugl-Meyer scale in Brazil. Rev bras fisioter. 2006; 10(2): 177-183.

16. Jaracz K, Grabowska-Fudala B, Górna K, Kozubski W. Consequences of stroke in the light of objective and subjective indices: a review of recent literature. Neurol Neurochir Pol. 2014; 48(4): 280-286.

17. Cavaco NS, Alouche SR. Upper limb functional outcome instruments for poststroke patients: a systematic review. Fisioter Pesqu. 2010; 17(2): 178-183.

18. Santos CM, Pimenta CB, Nobre MR.The PICO strategy for the research question construction and evidence search. Rev Latino-Am Enferm. 2007; 15(3): 508-511.

19. Galvão TF, Pansani TS, Harrad, D. Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. Epidemiol Serv Saúde. 2015; 24(2): 335- 342.

20. Carvalho APV, Grande AJ. Avaliação do risco de viés de ensaios clínicos randomizados pela ferramenta da colaboração Cochrane. Diagn Tratamento. 2013; 18(1): 38-44.

21. Amasyali SY, Yaliman A. Comparison of the effects of mirror therapy and electromyography-triggered neuromuscular stimulation on hand functions in stroke patients: a pilot study. Int J Rehabil Res. 2016; 39(4): 302-307.

22. Wu CY, Huang PC, Chen YT, Lin KC, Yang HW. Effects of mirror therapy on motor and sensory recovery in chronic stroke: a randomized controlled trial. Arch Phys Med Rehabil. 2013; 94(6): 1023-1030.

23. Lin KC, Huang PC, Chen YT, Wu CY, Huang WL. Combining afferent stimulation and mirror therapy for rehabilitating motor function, motor control, ambulation, and daily functions after stroke. Neurorehabil Neural Repair. 2014; 28(2): 153-162.

24. Cristina LM, Matei D, Ignat B, Popescu CD. Mirror therapy enhances upper extremity motor recovery in stroke patients. Acta Neurol Belg. 2015; 115(4): 597-603.

25. Chan WC, Au-Yeung SSY. Recovery in the Severely Impaired Arm Post-Stroke After Mirror Therapy: A Randomized Controlled Study. Am J Phys Med Rehabil. 2018; 97(8): 572-577.

26. Lee YY, Lin KC, Wu CY, Liao CH, Lin JC, Chen CL. Combining Afferent Stimulation and Mirror Therapy for Improving Muscular, Sensorimotor, and Daily Functions After Chronic Stroke: A Randomized, Placebo-Controlled Study. Am J Phys Med Rehabil. 2015; 94(10 Suppl 1): 859-68.

27. Michielsen ME, Selles RW, van der Geest JN, Eckhardt M, Yavuzer G, Stam HJ et al. Motor recovery and cortical reorganization after mirror therapy in chronic stroke patients: a phase II randomized controlled trial. Neurorehabil Neural Repair. 2011, 25(3): 223-33.

28. Mohan U1, Babu SK, Kumar KV, Suresh BV, Misri ZK, Chakrapani M. Effectiveness of mirror therapy on lower extremity motor recovery, balance and mobility in patients with acute stroke: A randomized sham-controlled pilot trial. Ann Indian Acad Neurol. 2013; 16(4):634-9.

29. Veerbeek JM, van Wegen E, van Peppen R, van der Wees PJ, Hendriks E, Rietberg M et al. What Is the Evidence for Physical Therapy Poststroke? A Systematic Review and Meta-Analysis. PLOS ONE. 2014; 9(2): e87987.

30. Pérez-Cruzado D, Merchán-Baeza JA, González-Sánchez M, Cuesta-Vargas AI. Systematic review of mirror therapy compared with conventional rehabilitation in upper extremity function in stroke survivors. Aust Occup Ther J. 2017; 64(2): 91-112.

31. Li Y, Wei Q, Gou W, He C. Effects of mirror therapy on walking ability, balance and lower limb motor recovery after stroke: a systematic review and meta-analysis of randomized controlled trials. Clinical Rehabilitation. 2018, 32(8): 1007-1021.

32. Hung GKN, Li, CTL, Yiu, AM, Fong KNK. Systematic Review: Effectiveness of Mirror Therapy for Lower Extremity Post-Stroke. Hong Kong Journal of Occupational Therapy. 2015; 26: 51-59.

33. Toh, SFM, Fong KNK. Systematic Review on the Effectiveness of Mirror Therapy in Training Upper Limb Hemiparesis after Stroke. Hong Kong Journal of Occupational Therapy 2012; 22(2):84-95.