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REVIEW ARTICLE

# Systematic Review: Effectiveness of Mirror Therapy for Lower Extremity Post-Stroke

**Goris Kin Nga Hung, Cabbee Tsz Lui Li, Alexander Miles Yiu*, Kenneth N.K. Fong**

*Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hong Kong Special Administrative Region*

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**Summary** *Background/Objective:* This study reviewed the current evidence on the effectiveness of mirror therapy (MT) on improving the motor functions of the hemiplegic lower extremity (LE) in adult clients with stroke.
*Methods:* A systematic review was conducted of studies published in English in the 10-year period 2005—2015, retrieved from seven electronic databases: Medline, PubMed, CINAHL, PsychInfo, Science Direct, Cochrane and TBI Rehabilitation. Only articles that focused on the effects of MT on hemiparesis affecting LE function and performance were included. The methodological quality of the studies was appraised using the Physiotherapy Evidence Database Scale (PEDro).
*Results:* The literature search yielded 14 studies that satisfied the selection criteria, of which five (4 randomised controlled trials and 1 case study) were reviewed after screening. Despite the heterogeneity of the studies, they showed MT to be effective in improving some of the motor functions of the LE at different stages of stroke. However, they offered little evidence on MT's long-term effects and for when is the optimal stage to start MT after stroke onset.
*Conclusion:* Further research is needed to determine the best treatment regimen and optimal time to initiate MT intervention in terms of the phases of stroke. No firm conclusions can be drawn on the effectiveness of MT on the hemiplegic LE until more evidence is available.


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* Corresponding author. Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Kowloon, Hong Kong Special Administrative Region.
*E-mail address:* Alexander-miles.yiu@connect.polyu.hk (A.M. Yiu).

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## Introduction

Cardiovascular accident (CVA) is the leading cause of death worldwide. Around 6.7 million people died from stroke in 2012. Stroke is also one of the leading causes of long-term disability, particularly in high- and upper-middle income countries (World Health Organisation, 2012). More than 60% of stroke survivors suffer from persistent neurological deficits that impair their activities of daily living (ADL). Stroke reduces mobility in more than half of survivors (World Health Organisation, 2014). Therefore, effective training strategies are needed to promote motor recovery and functional mobility.

Mirror therapy (MT) was first used in the treatment of phantom pain (Ramachandran, Rogers-Ramachandran, & Cobb, 1995). In 1999, Altschuler et al. introduced MT in stroke rehabilitation. Positive effects were found for stroke survivors with upper limb hemiparesis. During MT, a mirror is placed in the patient's midsagittal plane. He or she is then asked to perform specific movements in the unaffected limb while watching its reflection superimposed over the unseen impaired limb. MT is simpler, less labour-intensive and cheaper than other treatments (Yavuzer et al., 2008). The mechanism underlying its effects remains unclear. However, two hypotheses are often proposed. First, the cortical mechanism suggests that MT potentially normalizes an asymmetrical pattern of movement-related beta desynchronisation in the primary motor cortex (Rossiter, Borreli, Borchert, Bradbury, & Ward, 2015). On the other hand, the motor neuron mechanism hypothesis proposes that the excitability in the mirror neurons in the frontal lobes during MT facilitates functional recovery (Ramachandran & Altschuler, 2009; Yavuzer et al.). In addition, mirror visual feedback activates a broad network in the brain dedicated to attention and action monitoring (Deconinck et al., 2015).

Reviews have been conducted on the effectiveness of MT for patients with different conditions, including complex regional pain syndrome, phantom limb and stroke (Freysteinson, 2009; Rothgangel, Braun, Beurskens, Seitz, & Wade, 2011). The previous review shows a low quality of evidence regarding MT as an intervention to improve lower limb function after stroke (Rothgangel et al.). Furthermore, studies using imaging techniques have provided neurophysiological evidence for the application of MT to stroke with hemiplegia (Buccino et al., 2001; Fadiga & Craighero, 2004; Luft et al., 2005; Matthys et al., 2009). There have also been recent literature reviews on the effectiveness of MT in training upper extremity hemiplegics (Ezendam, Bongers, & Jannink, 2009; Toh & Fong, 2012) or motor function after stroke (Thieme, Mehrholz, Pohl, Behrens, & Dohle, 2012). However, to the best of our knowledge, no review has yet been done purely on the effectiveness of MT on the lower extremity (LE) for adult stroke survivors. The objective of this study was therefore to review the current evidence for this.

## Methods

### Search strategy

A systematic literature search was performed for articles published in the 10-year period 2005—2015. Studies were identified using seven electronic databases, namely Medline, PubMed, CINAHL, PsychInfo, Science Direct, Cochrane and TBI Rehabilitation.

The following keywords were used for searching: 'mirror visual feedback' or 'mirror therapy' or 'mirror box' and 'lower limb' or 'lower extremity' or 'ankle' or 'motor recovery' and 'stroke' or 'CVA' or 'cardiovascular accident/disease'.

### Selection criteria

Full-text articles published in English were selected. All clinical trials (class I to IV studies) evaluating MT in stroke were considered. Studies involving adults aged over 18 years in all stages of stroke and with hemiparesis that affected LE function and performance were included, as were those looking at MT as an intervention with conventional training or without a control group. Duplicate studies as well as theses and articles where the full text was unavailable were excluded.

### Methodological quality assessment

The Physiotherapy Evidence Database (PEDro) scale was used to evaluate the methodological quality of randomised controlled trial (RCT) studies. RCTs scoring $\geq$ 6 are considered to be high-quality evidence. This assessment was not used as part of the selection criteria for this study.

## Results

### Study selection

Fourteen articles were identified from seven databases: Medline ($n = 3$), PubMed ($n = 5$), CINAHL ($n = 1$), PsychInfo ($n = 1$), Science Direct ($n = 2$), Cochrane ($n = 1$) and TBI Rehabilitation ($n = 1$). Of these 14 articles, only 7 publications were selected, mainly due to overlap. A further two articles were excluded because the full-text version was not available and one of them was a thesis (Figure 1).

### Characteristics of the studies

Five articles were selected for inclusion in this review: (a) Sütbeyaz, Yavuzer, Sezer, and Koseoglu, 2007; (b) Wada et al., 2011; (c) Mohan et al., 2013; (d) Abo Salem and Huang, 2015; and (e) Ji and Kim, 2015. One was a case study and the other four were RCTs. The methodological quality of the RCTs was rated using the PEDro Scale. Table 1 summarises the scores given to each article.

All four RCTs (Sütbeyaz et al., 2007; Mohan et al., 2013; Abo Salem & Huang, 2015; Ji & Kim, 2015) scored from 6 to 8 on the PEDro Scale, and accordingly were considered high-quality RCTs.

A total of 135 participants with 10 dropouts were included in this review. The sample size of the studies ranged from 9 to 40. The age of the participants ranged from 28 to 86. The onset of stroke in the participants varied. Two studies (Wada et al., 2011; Mohan et al., 2013)

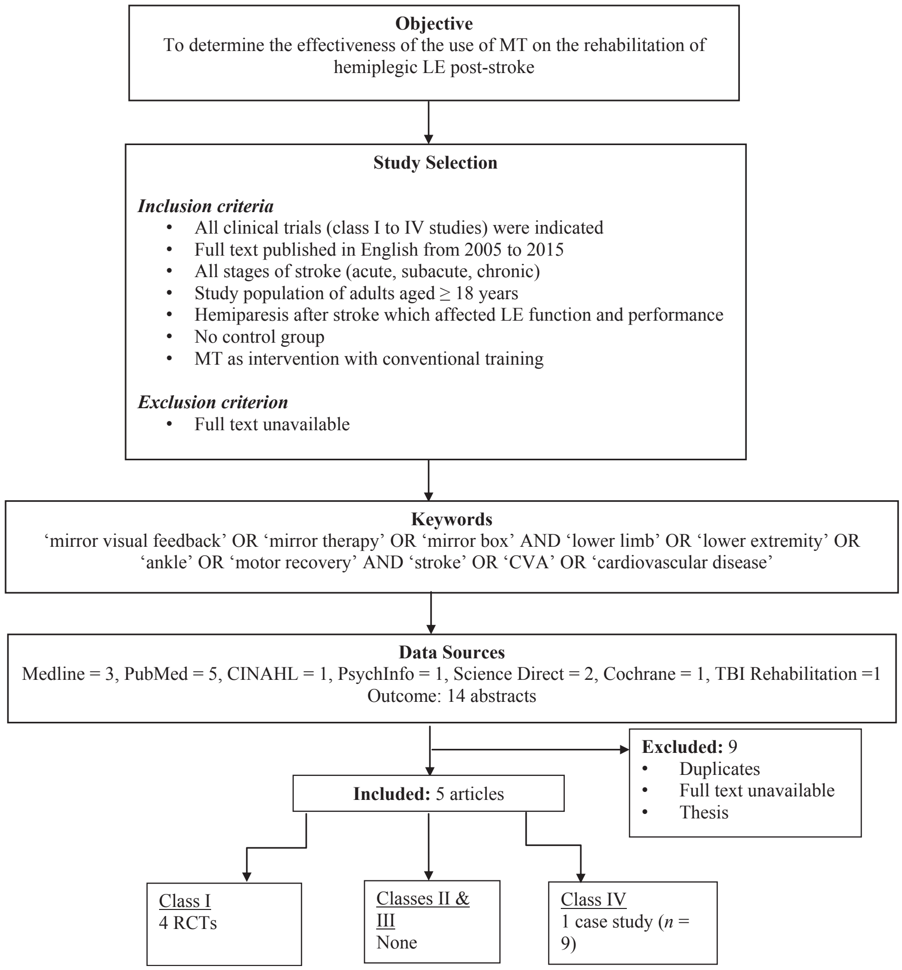


**Figure 1** Flowchart of the literature search and selection process. CINAHL = Cumulative Index to Nursing and Allied Health Literature; TBI = traumatic brain injury; MT = mirror therapy; LE = lower extremity; RCT = randomised controlled trial.

recruited participants at the acute stage (within 3 months); two (Sütbeyaz et al., 2007; Ji & Kim, 2015) in the subacute stage (3–12 months); and one (Abo Salem & Huang, 2015) in the chronic stage (> 12 months). The mean time post-stroke ranged from 6.41 days to 15.4 months. A summary of the participants' characteristics is shown in Table 2.

The frequency and duration of the interventions varied across the five studies. Three (Abo Salem & Huang, 2015; Ji & Kim, 2015; Sütbeyaz et al., 2007) offered MT training 5 days per week for 4 weeks. Mohan et al. (2013) provided treatment 6 days per week for 2 weeks. Participants in Wada et al.'s study (2011) received treatment for 7 days. The duration of each treatment session in four studies (Abo Salem & Huang; Ji & Kim; Sütbeyaz et al.; Mohan et al.) was 30 minutes; in Wada et al.'s study, participants performed a set of movements four times a day as their treatment regimen.

The types of outcome measures used included motor function assessment, functional rating assessment, and computerized assessment (Table 3).

## Effects of MT on LE motor performance

Improvement was shown in LE motor performance of the subjects after MT. The outcome measures used across the five studies varied. Two studies (Abo Salem & Huang, 2015; Sütbeyaz et al., 2007) showed improvement in motor recovery according to the Brunnstrom stages recovery model. One study (Mohan et al., 2013) used the Fugl-Meyer Assessment to measure the effectiveness of MT. The Functional Independence Measure (FIM) was used in one study (Sütbeyaz et al.). Ji and Kim (2015) used a motion analysis device to show improvement in single stance, step length and stride length after MT. One study (Abo Salem & Huang) showed improvement in ankle passive range of motion, which was measured by goniometry and gait speed using a 10-metre walk as the outcome measure. There was one study (Sütbeyaz et al.) that showed no improvement and another (Mohan et al.) that demonstrated improvement in Functional Ambulation Categories. Two studies (Abo Salem & Huang; Sütbeyaz et al.) found no effect on spasticity. One (Wada et al., 2011) showed no effect on foot function and ankle active range of motion.

## Effects of MT on LE motor performance at follow-up

Only one study (Sütbeyaz et al., 2007) involved a follow-up performed 6 months after MT intervention. The carry-on effect of MT was shown in the FIM motor score and the Brunnstrom stages as compared to the control group. No

**Table 1** PEDro Scale Scores for the Selected Studies.

| | | Sütbeyaz et al. (2007) | Ji & Kim (2015) | Mohan et al. (2013) | Abo Salem & Huang (2015) |
|---|---|---|---|---|---|
| | PEDro scale item | | | | |
| | Eligibility | Yes | Yes | Yes | Yes |
| 1 | Random allocation | 1 | 1 | 1 | 1 |
| 2 | Concealed allocation | 1 | 1 | 1 | 0 |
| 3 | Baseline comparability | 1 | 1 | 1 | 1 |
| 4 | Blind subjects | 0 | 1 | 0 | 0 |
| 5 | Blind therapists | 0 | 0 | 0 | 0 |
| 6 | Blind assessors | 1 | 1 | 1 | 0 |
| 7 | Adequate follow-up | 1 | 1 | 1 | 1 |
| 8 | Intention-to-treat analysis | 1 | 1 | 1 | 1 |
| 9 | Between-group comparisons | 1 | 1 | 1 | 1 |
| 10 | Point estimated variability | 1 | 1 | 1 | 1 |
| | Score | 8/10 | 9/10 | 8/10 | 6/10 |
| | Quality | High | High | High | High |

*Note*. PEDro scale = Physiotherapy Evidence Database scale.

effect was found for Functional Ambulation Categories or muscle spasticity.

## Discussion

### Effectiveness of MT for LE

All four RCTs (Sütbeyaz et al., 2007; Mohan et al., 2013; Abo Salem & Huang, 2015; Ji & Kim, 2015) were of good methodological quality according to the PEDro scale. The remaining article (Wada et al., 2011) was a case study, which is low-quality evidence.

MT can be effective in improving various functions, but it needs to be further investigated. Motor recovery (Sütbeyaz et al., 2007; Mohan et al., 2013; Abo Salem & Huang, 2015), ADL function (Sütbeyaz et al.), gait pattern (Ji & Kim, 2015), and gait speed and ankle passive range of motion (Abo Salem & Huang) are among the functions that have been shown to improve as a result of the use of MT with the LE (Hamdy, Rothwell, Aziz, Singh, & Thompson, 1998). It can be observed that MT, as a short-term visual feedback mechanism, aids cortical reorganization of the brain after injury to promote lower-limb function. Muscle tone (Sütbeyaz et al.; Abo Salem & Huang), balance function (Mohan et al.), foot function and ankle active range of motion (Wada et al., 2011) functions were not shown to improve with the application of MT. A systematic review by Toh and Fong (2012) indicated that MT in the upper extremity has no effect on spasticity. This could serve as a reference for future studies.

Two studies (Sütbeyaz et al., 2007; Mohan et al., 2013) yielded conflicting results on walking ability as measured with the Functional Ambulation Categories. The studies focused on different stroke stages (subacute for Sütbeyaz et al. and acute for Mohan et al.), which may have affected the results. In addition, both studies used different criteria for the Brunnstrom stage of their participants. Including those with stages 1–3 (Sütbeyaz et al.) or stage 2 and above (Mohan et al.) may have affected the effectiveness of MT in terms of ambulatory capability. Participants with lower functional ability but with better mobility recovery in the acute stage experienced more positive effects on walking ability after MT training.

### Long-term effects

One article (Sütbeyaz et al., 2007) reported improvements in ADL function and motor recovery on follow-up. However, the number of studies on the long-term effects of MT remains inadequate. More research using larger sample sizes and longer follow-up is required.

### Stage of stroke at which to apply MT

Due to the heterogeneity of the studies, no conclusion can be made on what constitutes the optimal stage at which to initiate MT. Three high-quality studies (Sütbeyaz et al., 2007; Mohan et al., 2013; Abo Salem & Huang, 2015) showed improvements in motor recovery at various stages of stroke.

The acute stage might be the optimal time to apply MT to improve walking ability (Mohan et al., 2013), whereas the subacute stage may be preferred for ADL function (Sütbeyaz et al., 2007) and gait (Ji & Kim, 2015). Using MT in the chronic stage may be beneficial for gait speed and ankle passive range of motion (Abo Salem & Huang, 2015). Although these studies show an improvement across the various stages of stroke, future studies need to explore this issue further.

### Intensity and duration of treatment regimen

Most of the studies used different protocols, so no conclusion can be drawn about the precise intensity of the treatment regimen. All of the high-quality studies (Sütbeyaz et al., 2007; Mohan et al., 2013; Abo Salem & Huang, 2015; Ji & Kim, 2015) showed varying intensities (at least 5–6 sessions per day for 2–4 weeks) and duration

**Table 2** Characteristics of Participants Recruited to Each Study.

| Reference | Diagnosis: stage of stroke | Group | Number of participants ($n$) / Age (y), mean ± SD | Sex (women /men) | Side of hemiparesis (right/left) | Severity of hemiparesis | Time since stroke, mean ± SD |
|---|---|---|---|---|---|---|---|
| Sütbeyaz et al. (2007) | Stroke: subacute (< 12 mo) | MT | $n$ = 20 / 62.7 ± 9.7 | 10/10 | 6/14 | Mean Brunnstrom stage: 2.4 ± 0.7<br>Mean MAS: 2.6 ± 0.5<br>Mean FAC: 1.9 ± 0.5<br>FIM motor score: 48.3 ± 5.5<br>No volitional ankle dorsiflexion | 3.5 ± 1.3 mo |
| | | Control | $n$ = 20 / 64.7 ± 7.7 | 7/13 | 7/13 | Mean Brunnstrom stage: 2.5 ± 1.0<br>Mean MAS: 2.3 ± 0.7<br>Mean FAC: 2.0 ± 0.7<br>FIM motor score: 50.2 ± 11.6<br>No volitional ankle dorsiflexion | 3.9 ± 1.9 mo |
| Wada et al. (2011) | Stroke: acute | MT | $n$ = 9 / 58.6 ± 14.9 | 5/4 | 5/4 | MAS: score 0 ($n$ = 1), score 1 ($n$ = 1), score 2 ($n$ = 4), score 3 ($n$ = 3)<br>SIAS-F (L/E position): score 0 ($n$ = 1), score 1 ($n$ = 4), score 2 ($n$ = 2), score 3 ($n$ = 2) | 76.9 ± 9.3 d |
| Mohan et al. (2013) | Stroke: acute (< 2 wk) | MT | $n$ = 11 / 62.6 ± 17.3 | 7/4 | 9/2 | Brunnstrom: stage 2 ($n$ = 2), stage 3 ($n$ = 7), stage 4 ($n$ = 2)<br>FAC: stage 0 ($n$ = 4), stage 1 ($n$ = 6), stage 2 ($n$ = 1)<br>Mean MCSI: 4.64 ± 1.5<br>Mean FMA: 19.36 ± 4.11<br>Mean BBA: 3.45 ± 1.37 | 7.1 ± 3.2 d |
| | | Control | $n$ = 11 / 63.3 ± 7.6 | 3/8 | 7/4 | Brunnstrom: stage 1 ($n$ = 3), stage 2 ($n$ = 5), stage 3 ($n$ = 1), stage ($n$ = 2)<br>FAC: stage 0 ($n$ = 5), stage 1 ($n$ = 4), stage 2 ($n$ = 2)<br>Mean MCSI: 4 ± 1.84<br>Mean FMA: 11.36 ± 6.73<br>Mean BBA: 2.55 ± 1.37 | 5.7 ± 3.5 d |
| Abo Salem & Huang (2015) | Stroke: chronic | MT | $n$ = 15 / 60.0 ± 1.8 | 7/8 | 9/6 | Mean ankle joint dorsiflexion AROM: 15.9 ± 2.33<br>Mean MAS: 2.75 ± 0.72<br>Mean Brunnstrom stage 3.1 ± 1.21<br>10-m walk test: 0.641 ± 0.34 | 14.9 ± 1.8 mo |
| | | Control | $n$ = 15 / 59.1 ± 9.1 | 8/7 | 8/7 | Mean ankle joint dorsiflexion AROM: 15 ± 1.49<br>Mean MAS: 2.9 ± 0.79 | 15.4 ± 1.3 mo |

(*continued on next page*)

**Table 2** (*continued*)

| Reference | Diagnosis: stage of stroke | Group | Number of participants (*n*) / Age (y), mean ± SD | Sex (women /men) | Side of hemiparesis (right/left) | Severity of hemiparesis | Time since stroke, mean ± SD |
|---|---|---|---|---|---|---|---|
| Ji & Kim (2015) | Stroke: subacute | MT | *n* = 17 / 55.2 ± 7.5 | 8/9 | 6/11 | Mean Brunnstrom stage 2.8 ± 1.15<br>10-m walk test: 0.609 ± 0.318<br>Single stance: 27.3 ± 9.4<br>Stance phase: 66.7 ± 6.3<br>Step length: 32.6 ± 7.3<br>Stride length: 61.4 ± 18.3<br>Swing phase: 33.5 ± 6.3<br>Velocity: 48.9 ± 21.3<br>Cadence: 67.8 ± 16.5<br>Step width: 17.4 ± 4.7 | 4.3 ± 1.5 mo |
| | | Control | *n* = 17 / 54.3 ± 8.7 | 9/8 | 8/9 | Single stance: 28.7 ± 8.2<br>Stance phase: 66.8 ± 6.2<br>Step length: 32.7 ± 6.1<br>Stride length: 62.5 ± 18.7<br>Swing phase: 33.7 ± 5.8<br>Velocity: 47.5 ± 19.7<br>Cadence: 69.2 ± 16.4<br>Step width: 17.2 ± 4.1 | 4.5 ± 1.3 mo |

*Note*. MT = mirror therapy; MAS = Modified Ashworth Scale; FAC = Functional Ambulation Categories; FIM = Functional Independence Measure; SIAS-F = Foot Functions of the Stroke Impairment Assessment Set; y = year; mo = month; wk = week; d = day; MCSI = Modified composite spasticity index; FMA = Fugl-Meyer Assessment; BBA = Brunel Balance Assessment; AROM = active range of motion.

**Table 3** Summary of Studies Investigating the Use of Mirror Therapy in Hemiplegic Lower Extremity Rehabilitation After Stroke.

| Reference | Study design | Length of study | Treatment regimen | Treatment activities | Outcome measures | Results |
|---|---|---|---|---|---|---|
| Sütbeyaz et al. (2007) | RCT ($n = 40$)<br>7 dropouts (patients could not come to follow-up clinic for financial reasons) | 4-wk intervention and 6-mo follow-up | Conventional stroke rehabilitation programme: 2–5 hr/d, 5 d/wk, 4 wk<br>MT or sham therapy: 30 min/d plus conventional training | Conventional programme included NDT, PT, OT and ST<br>MT group: performed flexion and extension movement of unaffected ankle while watching mirror reflection, without verbal feedback<br>Control group: performed same movement watching non-reflective side of mirror | • FAC<br>• FIM<br>• MAS<br>• Brunnstrom stages<br>Time of assessment:<br>• Pre-test<br>• Post-test 4 wk after end of intervention period<br>• Follow-up at 6 mo | Significant differences between groups at follow-up on FIM (mean improvement +21.4 in MT group vs. +12.5 in control group) and Brunnstrom stages (mean improvement +1.7 in MT group vs. +0.8 in control group)<br>No significant differences on MAS and FAC |
| Wada et al. (2011) | Case study ($n = 9$) | 14 d | MT training: four times/d for 7 d<br>After 7-d MT training, ordinary training only for 7 d | 50 dorsiflexion movements of the non-affected ankle joint to the rhythm of a metronome while watching mirror reflection | • SIAS-F<br>• AROM of ankle joint (foot–floor angle measured through video image)<br>Time of assessment:<br>• Pre-test<br>• 7 d after MT<br>• 7 d after ordinary training | Five of nine patients showed SIAS-F improvement after MT training<br>No significant difference in foot–floor angle of ankle joint |
| Mohan et al. (2013) | RCT ($n = 22$) | 2 wk | Conventional stroke rehabilitation programme: 2 hr/d, 6 d/wk for 2 wk<br>MT training/sham therapy: 30 min/d plus conventional training | Conventional programme included NDT, sensory motor re-education, active exercises, mobility training and balance and gait training<br>MT group: hip-knee-ankle flexion, moving knee inward, outward and extension, hip abduction, adduction and rotation, ankle dorsiflexion of the unaffected limb while watching mirror reflection<br>Control group: performed same movement while | • FAC<br>• FMA<br>• BBA<br>Time of assessment:<br>• Pre-test<br>• Post-test 2 wk after end of intervention period<br>• MCSI<br>• Brunnstrom stage of recovery | Both conventional and MT groups showed improvement in FMA and BBA (FMA, $p = .894$; BBA, $p = .358$)<br>MT group showed significant difference between groups in FAC ($p = .02$) |

(*continued on next page*)

**Table 3** (*continued*)

| Reference | Study design | Length of study | Treatment regimen | Treatment activities | Outcome measures | Results |
|---|---|---|---|---|---|---|
| | | | | watching non-reflective side of mirror<br>Both performed in 2 sets of 10 repetitions | Time of assessment:<br>• Pre-test for baseline comparison | |
| Abo Salem & Huang (2015) | RCT ($n = 30$) | 4 wk | Conventional stroke rehabilitation programme: 5 d/wk, 2–5 hr/d for 4 wk<br>Both groups received an extra 30 min in addition to conventional training | Conventional programme included OT, PT, electrotherapy, neurodevelopmental facilitation and gait training<br>MT group: the reflective side of the mirror faced the affected limb.<br>Practice consisted of:<br>1. Hip-knee-ankle flexion<br>2. Ankle dorsiflexion<br>3. Ankle eversion<br>Control group: same training and duration of exercises as the MT group but the non-reflective part of the mirror was used. | • Ankle dorsiflexion PROM<br>• MAS<br>• Brunnstrom stages<br>• 10-m walk test<br>Time of assessment:<br>• Pre-test<br>• Post-test at 4 wk after end of intervention period | MT group showed significantly improved ankle PROM (mean improvement +4 in MT group vs. +1.95 in control group), Brunnstrom stages (mean improvement +0.69 in MT group vs. +0.36 in control group), and walking speed (mean improvement +0.083 in MT group vs. −0.025 in control group)<br>No significant differences between the groups on MAS |
| Ji & Kim (2015) | RCT ($n = 34$)<br>3 dropouts due to family reasons and extremely poor health | 4 wk | Conventional stroke rehabilitation programme: 30 min/d, 5 d/wk, 4 wk<br>MT training/sham therapy: 15 min/d plus conventional training | Conventional programme consisted of NDT<br>MT group: performed flexion and extension movement of unaffected knee and ankle and hip flexion while watching mirror reflection, without verbal feedback<br>Control group: performed same movement while watching non-reflective side of mirror | • Motion analysis device<br>• Evaluating temporospatial gait characteristics<br>Time of assessment:<br>• Pre-test<br>• Post-test 4 wk after end of intervention period | Significant difference between MT and conventional groups in single stance (10.32 ± 4.14 vs. 6.54 ± 3.23), step length (8.47 ± 4.12 vs. 4.83 ± 2.14) and stride length (17.03 ± 6.57 vs. 10.54 ± 4.34)<br>No significant differences between groups on stance phase, swing phase, velocity, cadence and step width |

*Note*. RCT = randomised controlled trial; wk = week; mo = month; hr = hour; d = day; min = minute; NDT = neurodevelopmental programme; PT = physiotherapy; OT = occupational therapy; ST = speech therapy; MT = mirror therapy; FAC = Functional Ambulation Categories; FIM = Functional Independence Measure; MAS = Modified Ashworth Scale; SIAS-F = Foot Functions of the Stroke Impairment Assessment Set; AROM = active range of motion; FMA = Fugl-Meyer Assessment; BBA = Brunel Balance Assessment; MCSI = Modified composite spasticity index; PROM = passive range of motion.

(15—30 minutes). The five studies also shared a common treatment activity which involved ankle movement for at least 15 minutes, 5 days a week.

### Possible side effects

None of the studies showed that the treatment had any side effects. However, one study (Crosby, 2015) that was excluded from this review mentioned that MT may aggravate lower back pain if the client had it before stroke. More studies are needed to investigate the risks of MT and to identify adequate precautions.

### Limitations

The strength of this review is that the RCTs included are of high quality and cover different stages of stroke. Little evidence for applying MT was found for each stage. Due to the limited number of studies and differences in treatment regimens, the optimal duration of MT cannot be determined. Moreover, no conclusions about the carry-on effects of MT in LE can be drawn due to inadequate follow-up in the studies included in this review.

## Conclusion

This review shows that MT may be beneficial in improving some of the motor functions of the hemiplegic LE in stroke patients. However, there is limited evidence for its optimal use and specific treatment regimens at different stages of stroke. Therefore, no firm conclusions can be made about the effectiveness of MT until more evidence is available.

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