MIRROR THERAPY

The following is taken from the RCP National Clinical Guidelines for Stroke (2023). Please refer to the highlighted text that is specific to Mirror Therapy.

To view the full guidelines:
National Clinical Guideline for Stroke for the UK and Ireland. London: Intercollegiate Stroke Working Party; 2023 May 4. Available at: www.strokeguideline.org.
2023 edition

NATIONAL CLINICAL GUIDELINE FOR STROKE
for the United Kingdom and Ireland

4.18 Arm function

Approximately 70% of people experience loss of arm function after a stroke, and this persists for about 40%. This section includes interventions intended to deliver repetitive and functionally relevant practice to improve arm function. Guideline users should also refer to other relevant sections that cover the following: weakness (Section 4.17 *Motor impairment*), sensation (Section 4.47 *Sensation*), shoulder subluxation and pain (Section 4.23.3 *Shoulder subluxation and pain*), activities of daily living (Section 4.8 *Independence in daily living*). **[2023]**

Patterns of arm recovery are varied and are largely dependent on the initial degree of weakness and patency of the corticospinal tract (Stinear et al, 2017a), particularly preservation or return of finger extension and shoulder abduction. This has led to the development of tools to predict arm recovery in clinical practice: for example the SAFE and PREP2 tools (Nijland et al, 2010; Stinear et al, 2017b) and the Viatherapy app, an app to guide evidence-based rehabilitation (Wolf et al, 2016). Prognostic tools may be useful to help identify who is most likely to benefit from intensive upper limb interventions and who requires a compensatory approach focusing on reduction of secondary complications such as shoulder subluxation, pain and spasticity. **[2023]**

Whilst research regarding interventions to promote motor recovery has progressed, continued focus is required to ensure these are implemented into practice. Intensity of practice of movements and tasks during therapy must be coupled with efforts to translate movements into everyday activities. Current practice in the UK indicates too few rehabilitation sessions are dedicated to the upper limb and within sessions too few repetitions are achieved (Stockley et al, 2019). A co-ordinated multidisciplinary approach should be taken to maximise upper limb rehabilitation as well as ensuring that people are supported to practise outside of therapist-delivered sessions. **[2023]**

Management and recovery of the hemiplegic upper limb often takes place over months or years and must be considered in the context of other impairments including sensation, sensory or visual neglect, learnt non-use, spasticity and balance. Whilst promoting motor recovery (particularly early after stroke) is of the utmost importance, enabling the person to be independent in daily life activities, such as eating and drinking, is essential, and compensatory strategies should be used where appropriate. **[2023]**

Repetitive task practice

Recovery of the upper limb is best achieved through training that involves repetition of functional tasks and targeted exercises that follow motor learning principles. Components of functional tasks may be practised but should then be incorporated into practice of the whole functional task. Training should be supplemented with aids and equipment as necessary to enable safe, intensive and functionally relevant practice. **[2023]**

Electrical stimulation

Electrical stimulation has been used as an adjunctive treatment for the upper limb for many years. The most common form is therapeutic or cyclical electrical stimulation (also known as neuromuscular electrical stimulation [NMES]) to the wrist and finger extensors, which stimulates the muscles to contract in order to improve weakness and reduce motor impairment. **[2023]**

Vagus nerve stimulation

Vagus nerve stimulation (VNS) aims to enhance the effects of repetitive task training by stimulating the vagus nerve during the movement(s) being practised. It is therefore limited to use in people with mild-moderate upper limb weakness (typically, a Fugl-Meyer Upper limb Assessment score of 20-50/100). The stimulation is applied either by an implanted device directly attached to the vagus nerve, or indirectly by transcutaneous nerve stimulation over the vagus nerve in the left side of the neck or the sensory area of the nerve on the external part of the ear. The exact mechanism of action is unknown but it is associated with increased neuroplasticity (Hays et al, 2013; Engineer et al, 2019). **[2023]**

Constraint-induced movement therapy

The original constraint-induced movement therapy (CIMT) protocol incorporates three components of rehabilitation consisting of (1) intensive graded practice of the paretic arm for 6 hours a day for 2 weeks (shaping), (2) constraining the non-paretic arm with a mitt to promote use of the weak arm for 90% of waking hours, (3) a transfer training package to learn to use the paretic arm in a real-world environment completing functional tasks (Wolf et al, 2006; Taub et al, 2013). Original protocols for CIMT were found to be effective in improving arm function for people following a subacute stroke but only when all three components were used, and ‘forced use’ is not effective alone (Kwakkel et al, 2015). The time resource needed for CIMT has made this approach challenging to adopt in clinical practice. **[2023]**

In subsequent years various protocols have been developed aiming for 3-4 hours of CIMT, core components of which are consistent with the original intervention. These are now more commonly adopted in clinical practice, delivered by a combination of qualified therapists, rehabilitation assistants and self-practice, supported remotely as appropriate. Using the paretic arm in functional daily tasks remains a key feature of all modified CIMT (mCIMT) programmes and should be aligned to individualised goals. **[2023]**

Mental practice

Mental practice is a training method that involves repetitive cognitive rehearsal of physical movements in the absence of physical, voluntary attempts. From a practical perspective, mental practice constitutes a feasible alternative to other rehabilitation approaches to produce the movement because it does not require physical movement, can be performed without direct supervision, and requires minimal expense and equipment (Page & Peters, 2014). Mental practice may promote neuroplasticity, as neuroimaging studies have shown that similar overlapping brain areas are activated in mental practice and with physical movement (Di Rienzo et al., 2014). **[2023]**

Mirror therapy

Mirror therapy involves performing movements of the non-affected arm, whilst watching its mirror reflection hiding the affected arm. This creates a visual illusion of enhanced movement capability of the affected arm (Yang et al, 2018). The precise mechanisms of mirror therapy are not fully understood, but it is proposed that it promotes motor function of the upper limb via activation of the primary motor cortex or mirror neurones (Garry et al, 2005; Cattaneo & Rizzolatti, 2009). **[2023]**

Robotics

A robot is defined as a reprogrammable, multifunctional manipulator designed to move material, parts, or specialised devices through variable programmed motions to accomplish a task (Chang & Kim, 2013). Robot-mediated treatment uses devices to provide passive, active-assisted or resistive limb movement, and has the potential to offer extended periods of treatment and an opportunity to increase intensity through repetition. Some robots may be able to adapt treatment in response to performance. **[2023]**

Recommendations

A

People with some upper limb movement at any time after stroke should be offered repetitive task practice as the principal rehabilitation approach, in preference to other therapy approaches including Bobath. Practice should be characterised by a high number of repetitions of movements that are task-specific and functional, both within and outside of therapy sessions (self-directed). Repetitive task practice:

- may be bilateral or unilateral depending on the task and level of impairment;
- should be employed regardless of the presence of cognitive impairment such as neglect or inattention;
- may be enhanced by using trunk restraint and priming techniques. **[2023]**

B
People with stroke who have at least 20 degrees of active wrist extension and 10 degrees of active finger extension in the affected hand should be considered for constraint-induced movement therapy. **[2023]**

C
People with wrist and finger weakness which limits function after stroke should be considered for functional electrical stimulation applied to the wrist and finger extensors, as an adjunct to conventional therapy. Stimulation protocols should be individualised to the person's presentation and tolerance, and the person with stroke, their family/carers and clinicians in all settings should be trained in the safe application and use of electrical stimulation devices. **[2023]**

D
People with stroke without movement in the affected arm or hand (and clinicians, families and carers) should be trained in how to care for the limb in order to avoid complications (e.g. loss of joint range, pain). They should be monitored for any change and repetitive task practice should be offered if active movement is detected. **[2023]**

E
People with stroke may be considered for mirror therapy to improve arm function following stroke as an adjunct to usual therapy. **[2023]**

F
People with stroke who are able and motivated to participate in the mental practice of an activity should be offered training and encouraged to use it to improve arm function, as an adjunct to usual therapy. **[2023]**

G
People with arm weakness after stroke, who are able and motivated to follow regimes independently or with the support of a carer, should be considered for self-directed upper limb rehabilitation to increase practice in addition to usual therapy, e.g. patients undergoing constraint-induced movement therapy or functional electrical stimulation. **[2023]**

H
People with mild-moderate arm weakness after stroke may be considered for transcutaneous vagus nerve stimulation in addition to usual therapy. Implanted vagus nerve stimulation should only be used in the context of a clinical trial. **[2023]**

I
People with reduced arm function after a stroke may be considered for robot-assisted movement therapy to improve motor recovery of the arm as an adjunct to usual therapy, preferably in the context of a clinical trial. **[2023]**

Sources

A	Veerbeek et al, 2014b; French et al, 2016; Grattan et al, 2016; Wattchow et al, 2018; Chen et al, 2019; Zhang et al, 2021; da Silva et al,2020
B	Kwakkel et al, 2015; Corbetta et al, 2015; Barzel et al, 2015; Yadav et al, 2016; Liu et al, 2017; Abdullahi, 2018

C, D	Guideline Development Group consensus
E	Thieme et al, 2018; Yang et al, 2018; Zeng et al, 2018; Zhang et al, 2021
F	Page and Peters, 2014; Di Rienzo et al, 2014; Barclay et al, 2020; Stockley et al, 2021; Poveda-Garcia et al, 2021
G	Da-Silva et al, 2018; Guideline Development Group consensus
H	Dawson et al, 2021; Ahmed et al, 2022; Guideline Development Group consensus
I	Mehrholz et al, 2018; Takebayashi et al, 2020

Evidence to recommendations

Repetitive task practice

There is good quality evidence for interventions involving intensive, repetitive, task-oriented and task-specific training including constraint-induced movement therapy, mental practice, virtual reality and interactive video games (Pollock et al, 2014b). It remains unclear whether practising unilateral functional activities is more beneficial than bilateral practice, but this is likely to depend on a person's level of impairment. The evidence base for virtual reality and interactive video gaming-based interventions for the arm (as an adjunct to usual care to increase overall therapy time) is developing, though studies are often of low quality and further research is needed before recommendations can be made regarding their use. **[2023]**

The ideal dose of repetitive task practice required to be beneficial remains unclear (Lang et al, 2009; French et al, 2016a) but is likely to be substantially higher than is currently being delivered (Schneider et al, 2016; Clark et al, 2021) and in the order of several hundred repetitions per day (McCabe et al, 2015; Daly et al, 2019; Ward et al, 2019; Hayward et al, 2021). This can lead to both short-term and sustained improvements in arm and hand function in people with both subacute and chronic stroke (French et al, 2016a; Wattchow et al, 2018) even in those with cognitive impairments such as neglect or inattention (Grattan et al, 2016). **[2023]**

Adding trunk restraint to task-oriented arm and hand training can further improve impairments and activity within the first six months after stroke by limiting compensatory movements (Zhang et al, 2022). There is some evidence that priming activities can enhance training effects, with moderate quality evidence for brain stimulation or sensory priming, and low quality evidence for motor priming to enhance improvements in impairments and activity (da Silva et al, 2020). Brain stimulation usually involves transcranial magnetic or direct current stimulation, sensory priming involves electrical or sensory stimulation and motor priming involves aerobic activity or bilateral activities (da Silva et al, 2020) but there is little information on the appropriate dose, timing or type of priming activity. **[2023]**

High quality systematic reviews and meta-analyses provide sufficient evidence to discourage routine use of Bobath therapy in place of repetitive training or practice of functional tasks (Veerbeek et al, 2014b; Wattchow et al, 2018). **[2023]**

Electrical stimulation

Four good quality systematic reviews with meta-analysis have shown that electrical stimulation to the wrist and hand can improve motor impairments and function (Yang et al, 2019; Tang et al, 2021; Kristensen et al, 2022; Loh et al, 2022). Tang et al (2021) included a network meta-analysis which indicated that functional electrical stimulation to the wrist and finger extensors during practice of functional tasks was more effective at improving upper limb function than passive neuromuscular electrical stimulation, especially when used to enable repetitive task practice (Yang et al, 2019). A suggested way to do this is by coupling stimulation of the weak arm with movements of the unaffected arm (referred to as contralaterally controlled functional electrical stimulation; Loh et al, 2022). The optimal dose and stimulation protocol are still unclear so clinical decisions should be made according to an individual person's needs, goals and preferences. **[2023]**

Vagus nerve stimulation

High quality evidence from systematic reviews of six RCTs of vagus nerve stimulation (VNS; n=237; (Xie et al, 2021; Zhao et al, 2021; Ahmed et al, 2022)); including a phase III trial of implanted VNS in 108 people with chronic stroke (Dawson et al, 2021), showed VNS can enhance the effect of repetitive task practice on upper limb impairment, with a moderate effect size. All trials which reported on safety found VNS to be safe. However, many factors remain unclear, such as the optimal dose and stimulation parameters, integration of stimulation with repetitive task practice and identifying those who benefit most. Further research is needed to understand these factors, and the relative merits of implanted or transcutaneous stimulation. Furthermore, the dose of repetitive task training is likely to be important; it is unlikely that VNS would be effective without a high dose of repetitive task practice, which is currently rarely achieved in practice. VNS may be considered, when it can be provided without reducing the amount of practice completed, alongside other priming techniques according to patients' presentation, goals and preferences. **[2023]**

Intensive upper limb programmes

Whilst findings from single-centre studies of specialist intensive upper limb programmes for selected patients appear promising (Daly et al, 2019; Ward et al, 2019), there was insufficient high quality evidence to make general recommendations regarding provision of such programmes. Providing the evidence-based, intensive upper limb treatments contained in the recommendations in this section at a sufficient dose should remain the priority, along with delivering generalisable RCTs of intensive upper limb programmes in chronic stroke. Providers and commissioners/service planners should ensure access for all people with stroke who could benefit from rehabilitation at the intensities recommended, including measures to ensure therapy can be replicated and maintained over the longer term at home. **[2023]**

Constraint-induced movement therapy

Constraint-induced movement therapy (CIMT) includes an extended daily period of constraint of the non-paretic arm, repetitive task training for the paretic arm (shaping and task practice) and a 'transfer package' to support implementation into everyday life. Evidence suggests the transfer package is of particular importance, ensuring that motor gains translate into functional tasks and improve outcomes. Outcomes generally relate to arm function and effects are mostly confined to the trained activities (Pollock et al, 2014a; Pollock et al, 2014b; Veerbeek et al, 2014b). Challenges in clinical delivery and adherence to original CIMT protocols have resulted in modified CIMT (mCIMT) being adopted, where the time during which the non-paretic arm is constrained is reduced and the training hours spread over a longer period of time. Other mCIMT protocols have explored different methods and locations of delivery, for example home, clinic or remote delivery. Both CIMT and mCIMT improve arm function and activities of daily living in people with mild-moderate weakness (that is at least 20 degrees of active wrist extension and 10 degrees of active finger extension in the affected hand) in people with acute and subacute stroke (Corbetta et al, 2015; Kwakkel et al, 2015; Liu et al, 2016). However, mCIMT protocols vary and the optimal way to modify CIMT is unclear (Barzel et al, 2015; Yadav et al, 2016; Abdullahi, 2018). **[2023]**

Future research should aim to identify the most effective mCIMT protocols to use in clinical practice for people with different degrees of weakness and disability (e.g. the duration and frequency of constraint). Research should also consider the acceptability of CIMT and mCIMT for people with stroke and consider the support required for its use. There is emerging evidence of successful alternative ways to administer CIMT/mCIMT for example through video games or telehealth (Smith & Tomita, 2020; Taub et al, 2021; Gauthier et al, 2022) that merit further investigation. **[2023]**

Mental practice

Mental practice is an adjunct to conventional therapy, which can lead to significant improvement in upper limb function in the acute, subacute and chronic phases after stroke (Barclay et al, 2020). There is some evidence that mental practice may be more effective in the first three months after stroke in people with the most severe arm weakness, but the required dose is unclear and further research is warranted (Barclay et al, 2020; Stockley et al, 2021). A small observational study has indicated that the ability to mentally visualise (i.e. imagine) movements should be assessed before prescribing mental practice (Poveda-Garcia et al, 2021). **[2023]**

Mirror therapy

Systematic reviews and meta-analyses provide moderate evidence that mirror therapy can improve arm function and activities of daily living for people after a stroke (Thieme et al, 2018; Yang et al, 2018; Zeng et al, 2018; Zhang et al, 2021). **[2023]**

Mirror therapy is only effective for improving arm function as an adjunct to therapy or compared to a placebo (Thieme et al, 2018). Mirror therapy is not superior to dose-matched, conventional rehabilitation that involves upper limb action observation, movement or functional training (Lin et al, 2019). More robust research is required, and future research should focus on defining the most effective treatment protocols and the patients for whom it is most beneficial (Morkisch et al, 2019). Systematic reviews also suggest that mirror therapy may be effective in the treatment of pain and neglect, but this was not a focus of the 2023 update. **[2023]**

Robotics

A Cochrane review (Mehrholz et al, 2018) concluded that electromechanical and robot-assisted arm training resulted in a slight improvement in activities of daily living, muscle strength and arm function. However, a variety of types of robot were used and the dose of training was under-reported making it unclear how robotics could be routinely adopted in practice. Further uncertainty comes from suggestions from other trials that the effects of robotic therapy on arm function are confined to secondary outcomes in people with subacute stroke when combined with conventional therapy (Takebayashi et al, 2022) or only if enhanced by the addition of functional electrical stimulation (Straudi et al, 2020). A further systematic review suggested robotic therapy maybe slightly superior to therapist-led training (Chen et al, 2020) while other studies indicate that including robotic therapy in a conventional therapy session could achieve similar improvements to conventional therapist-led treatment but with less staffing resource (Aprile et al, 2020; Budhota et al, 2021). Further research is needed to find ways to translate the improvements in upper limb impairment seen with robot-assisted training into meaningful benefits in upper limb function and activities of daily living (Rodgers et al, 2019a). In the meantime, teams may consider or continue supplementing face-to-face therapy with robot-assisted arm training and be reassured regarding its safety, and seek opportunities for their patients to participate in research studies. Future research should include non-inferiority or equivalence trials, as it may be that equivalent clinical outcomes can be achieved using less resource. The target population should be people with severe arm weakness and less potential for spontaneous recovery (Wu et al, 2021). An economic evaluation concluded that robot-assisted therapy was not cost-effective, and also recommended further research (Fernandez-Garcia et al, 2021). **[2023]**

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