

The Effectiveness of Robotic Mirror Therapy for Upper Limb Function Recovery after Stroke

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Abstract

Robotic Mirror Therapy is conducted based on Bilateral Mirror Therapy, and it could significantly strengthen the effect of Mirror Therapy on helping recovering stroke patients who are diagnosed with upper-limb hemiplegia

Keywords: Robotic; Mirror therapy; stroke patients; RMT

Introduction

Mirror therapy is a method that is known as effective when used to help patients recover their limb function after their amputation surgery. It typically involves placing the affected limb behind the mirror to make it out of sight and moving the unaffected limb while viewing it in the mirror. As physicians explored more, mirror therapy was developed into two categories: Unilateral Mirror Therapy (UMT), mirror therapy that requires the affected limb to stay still behind the mirror, and Bilateral Mirror therapy (BMT), mirror therapy that asks the physical movement of the affected limb. Based on BMT, Robotic Mirror Therapy (RMT) was also introduced to help improve stroke patients' motor function with the assistance of electronic devices and technology for visual and physical feedback.

This review focuses mainly on the effectiveness of RMT for upper limb recovery after stroke and what makes it more advantaged.

The Effectiveness of RMT

Instead of using a mirror to do the therapy traditionally, RMT could be an extension by achieving bilateral arm movement with robots that apply mechanical connections to provide sensory and visual feedback. According to a study that compares MT and RMT with robotic gloves, RMT with a bilateral approach seems to have higher treatment effectiveness on motor function (Schrader et al., 2022).

Taking a 60-year-old male patient with chronic right basal ganglia hemorrhage as a representative example, after 10 sessions of RMT, his upper limb function has been proved to be improved by a series of tests, including Fugl-Meyer assessment (Beom et al., 2016).

Another experiment compared the effectiveness of Mirror therapy with robot-assisted therapy and Sham mirror therapy with robot-assisted therapy. According to the author, data in this experiment indicates that "chronic stroke

survivors seem to benefit from robot-assisted therapy in upper limb function and functional independence. Applying mirror therapy before robot-assisted therapy could further improve self-efficacy for stroke patients. Although mirror therapy did not significantly augment the effects of robot-assisted therapy on objective measures of upper limb function, stroke patients who received mirror therapy before robot-assisted therapy significantly improved their confidence in performing daily activities." (Chen et al., 2023).

Moreover, RMT can trigger higher activation on the contralateral motor cortex of the affected hand compared to MT and RT, and the researcher concluded that visual and somatosensory feedback and motor intention are critical parts that lead to this result (Kim et al., 2022).

UMT and BMT

As RMT could be viewed as an extension created based on BMT's theory, it is important to know how BMT differs from traditional therapy (UMT). Based on a study that compared the effectiveness of MT with and without bilateral arm training, patients' performance when receiving MT combined with bilateral training was better (Samuelkamaleshkumar et al., 2014). In another research focusing on UMT and BMT's effectiveness on unilateral neglect, the researcher concluded, "BMT was more effective than UMT in reducing the symptoms of unilateral neglect and improving ADL performance" (Sim and Kwon, 2022).

Thus, the notable improvement for patients who accepted RMT might come from the bilateral movement during the process, but not purely the visual and sensory feedback the robots or devices provided.

Conclusion

According to the information above, RMT is known to be effective and, so far, one of the best options in the mirror therapy category for upper limb function recovery. How-

ever, more research is still needed to draw further conclusions on which part of RMT makes it more effective, whether the visual feedback, the sensor feedback, or the guidance for the affected limb's passive movement.

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