Future Implications of Virtual Reality for Occupational Therapy in Stroke Patients

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According to Statistics Canada, the third largest cause of death amongst Canadians is a stroke (Statistics Canada, 2017). Furthermore, stroke has been found to be the tenth highest factor in the number of years an individuals have lost because of poor health, disability, or premature death, also known as disability-adjusted life years (DALY) (Uthman, 2016)). A common symptom experienced after stroke involves a decrease in sensation or limited mobility in parts of the body (Dhamoon et al., 2009). Following a stroke, individuals often participate in occupational therapy as a part of their rehabilitation plan, as it has been shown to result in vast improvements for recovery (Legg & Langhorne, 2006). Lately, the potential role of virtual reality (VR) within rehabilitation has been discussed, particularly regarding the benefits, implications, and further technological advancements to assist in the recovery of stroke patients.

VR uses computer modeling to simulate a virtual environment, allowing individuals to experience and interact within this environment (LaValle, 2023). VR can be separated further into two categories: non-immersive VR and immersive VR. In non-immersive VR, the environment does not fully override one's perception as participants are in control of the environment (Kim et al., 2020). This form of VR also uses stereoscopic vision technology to view 3D objects (Kim et al., 2020). Conversely, immersive VR engages the participant more, using devices such as a head-mounted display, tracking devices, haptic devices, wireless controllers, and data gloves (Kim et al., 2020). From a clinical perspective, both forms of VR have been used as a part of a rehabilitation strategy following stroke and a recent meta-analysis has shown that the inclusion of either non-immersive or immersive VR as a part of an individual's rehabilitation has led to improvements within one's static and dynamic balance (Garray-Sanchez et al., 2021).

The implications of VR use for stroke rehabilitation proposes a multitude of benefits. Firstly, the use of VR allows the occupational therapist to have full control over the environment and risk-taking can be done safely (Laver et al., 2011). Furthermore, VR permits the practitioner to create a setting which appropriately challenges one's development based on the current stage of recovery (Laver et al., 2011). Within the clinical setting, practitioners can place physical objects in spots which would align with what the participant sees in VR, strengthening the connection between performing movements in the virtual environment and proficiency in the real world (Kim et al., 2020). Additionally, the use of VR allows for the participant to be exposed to a variety of situations beyond what traditional rehabilitation can allow (Laver et al., 2011). The use of VR to support motor rehabilitation has been found to show improvements when used by the participant outside of the clinical setting in conjunction with conventional therapy as it grants the patient the ability to practice tasks more frequently, leading to greater mastery (Kim et al., 2020). Finally, a major benefit of VR for rehabilitation is the gamification aspect as it allows the participant to perceive the therapy as more enjoyable, increasing the likelihood of the adoption and maintenance of active therapy (Kim et al., 2020).

While the use of VR to improve recovery after stroke has many perceived benefits, there are some potential drawbacks regarding its use. Currently, a large drawback of this technology is the lack of high-quality studies which research the maintenance period after the intervention's initial adoption (Kim et al., 2020). Furthermore, there is a lack of research regarding the optimal stage of recovery to implement this intervention and the difficulty of creating a customizable program becomes a substantial barrier for the practitioner (Kim et al., 2020). Similarly, many clinics may not have the infrastructure needed to set up this technology and practitioners may not feel equipped to utilize this technology due to lack of knowledge (Kim et al., 2020). The practitioner must also consider individual factors such as the patient's proficiency and compliance with the VR technology as well as any motor or sensory impairments (Kim et al., 2020).

Within this field, two innovative technological aspects have been assessed which could further strengthen the argument for increased use of VR in stroke rehabilitation. The first advancement involves the use of brain-computer interface (BCI) to improve the brain's adaptability, also known as neuroplasticity (Kim et al., 2020). Using motor imagery and the recording of brain activity, the BCI can provide instant feedback and provide cues for the participant through functional electrical stimulation (Van Dokkum et al., 2015). Furthermore, the BCI helps both the patient and practitioner to understand the restructuring of the patient's brain following a stroke as it quantifies changes in plasticity within the neural network (Van Dokkum et al., 2015). Previous studies have concluded that the use of BCI in conjunction with VR can enhance upper limb rehabilitation and the analysis of brain signals may help to forecast motor movements (Pichiorri et al., 2015). The second advancement involves the use of non-invasive brain stimulation, including transcranial magnetic stimulation (TMS) (Talelli & Greenwood, 2006). This consists of the usage of high-frequencies to stimulate ipsilesional brain signals and low-frequencies to impede contralesional brain signals, both of which have proven to facilitate recovery (Kim et al., 2020). Used in conjunction with VR rehabilitation, researchers have found improvements in therapy outcomes (Johnson, 2018). Similar to the use of VR, the implementation of BCI and non-invasive brain stimulation face those same barriers (Kim et al., 2020).

Overall, the technology used in VR is advancing rapidly and while there has been some evidence regarding its use in the improvement of rehabilitation outcomes for stroke patients, more studies need to be completed to inform an evidence-based approach for policy and practice. Further research must be done to assess the optimal timing, intensity, and duration of VR-based therapy as well as whether immersive or non-immersive VR yields more positive outcomes. With regards to its implementation, there are various aspects to consider overcoming barriers within the clinical setting to improve accessibility of this technology Finally, the role of novel technologies in conjunction with both VR and conventional rehabilitation therapy must be further analyzed to ensure the ideal combination of treatment is achieved for stroke patients.

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