



LITERATURE OVERVIEW:

Virtual Reality For In-Patient & Out-Patient Use / SCI Treatment

Spinal Cord Injury (SCI) rehabilitation continues to be a clinical challenge as healthcare providers implore unique sets of activities, physical therapy (PT), occupational therapy (OT) and gait training to strengthen muscles, maintain bone density, and improve range of motion for patients to achieve the highest possible quality of life. While many clinical observations have been observed in the treatment of SCI, no approach has achieved consistent clinical improvement below the level of injury. Virtual Reality (VR) as an evolving technology has the unique capacity to immerse a person within a simulated environment by use of a VR headset, and transform their rehabilitation experience to outside of the typical clinical setting, opening new possibilities for treatment. Immersive VR experiences have the benefit of causing patients to suspend their disbelief and fully mentally engage with their virtual environment, resulting in less focus on the time spent in treatment; and is perhaps more effective at reducing anxiety or exhaustion than other, less immersive methods of distraction or encouragement.

Virtual Reality has become significantly more advanced and portable over the last 5 years, and easily applicable for non-invasive in-patient and out-patient treatment. Several studies have evaluated the effectiveness of VR in pain management^{1,2,3,4}, anxiety treatment⁵, physical therapy⁶, and gait training⁷ with positive results. For the use of VR in hospitalized patients, the results indicate that VR is an effective and safe therapy for pain management with significant reduction in pain reported by patients.⁸ From pain management to physical rehabilitation, VR continues to advance treatments for pediatric and adult patients suffering from SCI, TBI, Cerebral Palsy, stroke, Autism, Parkinson's disease, burn treatments, and more.

In one study utilizing virtual reality treatment, all eight patients studied regained voluntary motor control in key muscles below the SCI level as measured by EMGs, resulting in marked improvement in their walking index, with 50% of the trial participants being upgraded to incomplete paraplegia at the end of the study. Neurological recovery was paralleled by the reemergence of lower limb motor imagery at cortical level and somatic sensory improvements.⁹ In another compelling case study, researchers suggest that training with a healthy hand through VR programming could effectively 'trick the brain' by having healthy limbs lead by example.¹⁰ This marks significant achievement through immersion in a virtual environment, where the brain adopts a new reality being presented.

Patients with cerebral palsy participating in physical therapy intended to maximize range of motion and motor control reported 41.2% less pain while using virtual reality during therapy than patients who were not using VR.¹¹ With notably smaller sample sizes in pediatric medicine, research has also been conducted with children who have cerebral palsy participating in rehabilitation exercises, which has shown that interactive VR can increase their postural control and feelings of self-efficacy.¹²

The measured benefits of virtual reality treatment can be as advanced as muscle engagement and movement below the injury, or on the level of mental wellness and fighting depression. Adult patients utilizing VR during their first chemotherapy session reported significantly reduced anxiety during subsequent treatments, even if VR was not being used in the following treatments, suggesting a parallel application for SCI patients entering intensive rehabilitation regimens.¹³ As observed in the clinical setting, VR inherently has both a strong excitability factor, and in situations where PT can be both grueling and intensive, VR has been expressed to motivate patients and distract them from the intensity of their therapy, in some cases patients underestimating treatment duration by 25% – resulting in willingness to participate longer and at higher overall intensity.¹⁴

Overall, the more immersive, high tech and interactive the VR experience is, the more effective it is. When comparing interactive VR (games, activities, and storylines) to “passive” VR (in which the digital environment is simply viewed), adult patients report a 32% greater reduction in time spent thinking about pain or discomfort, and a 75% greater reduction in affective anxiety using interactive VR.¹⁵ The efficacy of VR in pain management does not wear over time either, with reports of VR pain reduction remaining equally strong across treatments.¹⁶ Mieron provides a comprehensive library of interactive VR games and experiences in which patients are coached, encouraged, and the user is the controller of the gaming environment, offering the most immersive platform for diverse clinical use.

Pertaining to feasibility data, 86% of young adult patients using VR during treatment expressed enjoying utilizing VR, while universally across studies of pediatric and adult patients, 82% would use it again.¹⁷ By way of VRs capacity to place a person within an immersive, interactive computer generated simulation environment, new possibilities exist that go well beyond former methods of care and rehabilitation, further advancing patient outcome.

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