

Penumbra and VIVE Partner To Develop Innovative VR Solutions That Help Heal the Body and Mind



With the help of Penumbra’s REAL System and HTC VIVE, medical professionals are using innovative VR solutions to improve stroke rehabilitation and enhance patients’ mental wellness and well-being

Strokes present a serious health crisis. In the U.S. alone, someone has a stroke every four seconds, according to the [Centers for Disease Control](#). That adds up to more than 795,000 stroke patients every year. The good news is that stroke survival rates have [improved significantly](#) over the past few decades. However, that raises another important issue. There are more stroke survivors living today who need help. Stroke can have devastating effects on the body and mind. After a patient leaves acute care, they often need long-term rehabilitation to counteract the debilitating issues of stroke and move ahead on their journey to leading a happy, healthy life.

The focus of rehabilitation is bringing back functions and optimizing them, reducing incapacitating problems and, ultimately, improving quality of life. Unfortunately, as anyone

who has participated in physical and/or occupational therapy can attest, it is rarely fun and engaging. While most therapists are energetic and empathetic people, one of their primary jobs is to continually challenge their patients to push through their discomfort in order to improve.

Outpatient rehabilitation presents other hurdles in terms of access and availability. In areas where patients outnumber therapists and facilities, patients may have to wait to begin therapy and struggle to find appointments that are convenient for them and have to wait to begin therapy – which could lead to worsening symptoms. In rural areas, these problems can be exacerbated by long distances between patients and therapists.

While stroke treatments have become more effective in

helping people survive these episodes, it's abundantly clear that clinicians, patients, and their families need more convenient and accessible options when it comes to the long-term work of helping stroke survivors maximize their outcomes.

Evidence-based approach powers new solutions

Enter Penumbra's REAL Immersive System featuring HTC VIVE. Together with HTC, Penumbra develops virtual reality (VR) solutions to give therapists and their patients a boost in recovering from a stroke, along with many other medical conditions that can have similar negative effects on a person, requiring rehabilitation.

This innovative technology is based on years of research and study. To date, there have been more than 5,000 journal articles, 600 randomized controlled trials, and 135 meta-analyses demonstrating the value of VR in the healthcare setting, including in rehabilitation. These studies commonly show improved patient engagement, enhanced memory-learning effect [1], and better outcomes than with conventional therapy alone [2].

Penumbra is a global healthcare company based in Alameda, Calif., focused on innovative therapies to address unmet needs across several conditions, including stroke, aneurysms, and rehabilitation. Penumbra's diverse team of engineers, artists, and developers, along with clinical experts from around the world, have collaborated to develop the REAL System. Combining Penumbra's proprietary VR sensor technology and software with HTC VIVE hardware, the REAL System was granted FDA clearance in 2019 to address the specific needs of rehabilitation patients.

"We have an incredible partner in HTC VIVE. Penumbra's first products include all sorts of technology typically used in interventional surgery, including catheters, wires, stents, and coils," said Gita Barry, EVP and General Manager, REAL System. "It's due to our passion for addressing patient needs that we expanded our offering to bring medical devices and VR tech together. In partnership with HTC, we've created a new expanded world of rehabilitation solutions."

REAL System includes an HTC VIVE all-in-one VR headset powered by the Qualcomm™ Snapdragon XR2 platform, five wireless body sensors to support the immersive experience, and a tablet with TherapyView™ software that allows therapists to supervise and customize the many evidence-based rehabilitation activities.



REAL System's activities are designed to be both fun and engaging while addressing motor cognitive functions. Activities for motor function focus on upper extremity strengthening, ROM, and postural control. Activities for cognitive functions include visuospatial awareness and command-response. Under the supervision of a medical professional, patients don the HTC VIVE headset to experience fun and interesting VR experiences. The system empowers patients with engaging therapeutic activities that offer almost endless possibilities. The technology tracks the user's motion and allows them to see their body in the environment while minimizing the potential for motion discomfort. Moreover, the software enables clinicians to visualize patient progress with objective data after each session and trends over time.

Joseph Graham, a physiatrist in Chicago who has been using REAL System, explained: "Data tracking and keeping an eye on patients' progress through all the motions, while also making it a fun experience for the patient, really helps the patient and then the therapist to monitor what's going on throughout therapy to make sure they are doing the right things."

"The mind forgets 'I had a stroke' "

One VR experience that has become especially popular is called Nest Hop. The idea behind the experience is to work with rehabilitation patients to enhance their activities related to daily living – such as taking groceries out of a bag

and placing them in the pantry – in a much more engaging manner. In Nest Hop, patients pick up a bird and place it in a series of nests. This activity is similar to functional exercises the patient would be performing with their therapist in a facility, particularly as it relates to dynamic reaching. Therapists can adjust VR settings to help patients improve how far and how high a patient can reach.

One stroke survivor, Deb (last name withheld for confidentiality), enjoyed using Nest Hop while rehabilitating from a stroke.



“When you’re in the REAL System,” she said, “you’re just thrust into something so wonderful that the mind forgets, ‘I had a stroke.’”

Another VR experience, Chuckle Ball™, engages patients in blocking a fish with a ball controlled by their hands and head – similarly designed to mimic real-life activities. Therapists can use Chuckle Ball to focus on functional movement patterns with an emphasis on dynamic reaching, postural control, reflexes, and other factors. Instead of working with balls in a facility, a therapist can challenge a patient virtually, increasing the number of balls and the frequency of fish – adjustments that are more difficult to make in a real-world setting.

“We bring together technology and the fundamentals of healthcare, medical device development, and all of the incredible clinical data that supports this technology,” added Barry. “What we’ve learned is that the immersion in a VR experience where patients see their avatar’s movements changes the patient’s world. They’re able to do things that they weren’t sure they were able to do in the real world. It

doesn’t mean they weren’t necessarily capable. It just means they weren’t sure. It gets them past that mental block and encourages them to take those next steps. Therapists can track progression and adjust settings. They can help keep their patients motivated as they continue along with their rehabilitation.”



VR enhances mindfulness and relaxation

Penumbra recently introduced the REAL i-Series™ – a virtual reality system designed for use by a broad range of care providers and mental health professionals to support people with depressed and anxious moods, pain and discomfort, loneliness and isolation, and age-related challenges. The REAL i-Series also features REAL Connect™, a first-to-market advanced capability, providing in-virtual reality, in-activity one-to-one real-time video and audio communication.

This solution combines HTC VIVE VR hardware with engaging, immersive, gaze-based apps and experiences. These include more than 10 hours of content with 360-degree travel and nature experiences that are both therapist-led and self-guided. Popular apps include World Traveler, Serene Lake, and Beach Retreats. Using REAL Connect, patients can share their experiences with caregivers, friends, and family members, which helps to build social connectedness.



“As we continue to advance this platform, it’s not just around rehabilitation or mental well-being,” said Barry. “We see so much opportunity for other patient types to take advantage of this immersive experience.”

A new, healthier future is on the horizon

While the negative impacts of stroke and similar neurological conditions are challenges that need solving, Penumbra’s REAL System and HTC VIVE are focused on developing entire VR-based hardware and software platforms that can alleviate many types of suffering. Both organizations are driven by the research that reveals a simple, powerful truth: patients who have exposure to VR-centric therapy experience better outcomes than those who do not.

Clinicians are witnessing many positive effects using VR systems specifically designed for rehabilitation and other clinical applications – rather than off-the-shelf technology better suited for gaming and consumer uses. Around the world, healthcare providers and their patients have been waiting for the day when advanced VR technology would make a long-term difference in physical and mental well-being. Now that day has finally arrived.

[1] Turolla, et al. J Neuroeng Rehabil 2013 Virtual Reality for the Rehabilitation of the Upper Limb Motor Function after Stroke: A Prospective Controlled Trial

[2] Hofmann, M., Rösler, A., Schwarz, W., Müller-Spahn, F., Kräuchi, K., Hock, C., et al. (2003). Interactive computer-training as a therapeutic tool in Alzheimer’s disease. Compr. Psychiatry 44, 213–219. doi: 10.1016/S0010-440X(03)00006-3

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