compared to conventional therapies. In a 2015 study, 10 chronic stroke patients were exposed to 30-minute VR training sessions in addition to conventional therapy, while the control group only received conventional therapy.[7] According to the Berg Balance Scale and 10m Walking Test, statistically significant improvements were found in balance and gait as compared to control participants.[7] Therefore, the trial asserted VR as an effective resource for rehabilitation. Overall, these studies suggest that VR can be a beneficial adjunct to conventional rehabilitation.

Another major aspect of rehabilitation is motivation. These simulations provide exciting incentives for patients to repeat limb movements in contrast to the traditional goal of reaching a target number of repetitions.[8,9] Rand et al. found that stroke patients using VR reported higher frequency of arm movements during therapy and reached greater intensities throughout their recovery period.[9] It is suggested that the purposeful goals designed in realistic VEs encourage patients to continue these repeated motions, unlike in comparatively dull therapy rooms.[3,9]

VR has led to significant improvements in both children and adult patients suffering from various motor diseases such as PD, spinal cord injury, and limb immobilization due to strokes.[4,5,8] This research suggests that VR training can be a valuable tool in supporting patient recovery by simulating various aspects of their regular lifestyle.

VR AS A NONPHARMACOLOGICAL ANALGESIC

The research into VR rehabilitation eventually led to another application for medical care. Patients with burn injuries undergo occupational and skin stretching therapy, and large amounts of pharmacological analgesics are required to suppress the excruciating pain.[2,10,11] With a focus on finding nonpharmacological solutions due to severe side effects and tolerance buildup, VR is proving to be a promising solution.[12]
A study by Hoffman et al. determined that VR generates greater compliance for occupational and skin stretching therapy, as participants reported pain reduction when immersed in the VR world.[2,10] These results were followed up with functional magnetic resonance imaging (fMRI) scans which demonstrated impressive reductions in the pain-sensing areas of the brain during VR use.[2] A larger study of 88 participants found similar reports of decreased pain.[10,13] It is stipulated that the sensation of pain requires attention to the location of stimulus in order for the brain to process the incoming signals. VR may impede this process by introducing a flood of new sensory information to divert the brain's attention.[2,10,12] To explore this hypothesis, a 2011 clinical trial measured reductions in pain, time spent thinking about pain, and general unpleasantness in 54 pediatric burn patients undergoing occupational therapy with and without VR. Their data showed significant reductions in physical pain and time spent thinking about their pain in the presence of VR, which led to the conclusion that VR enhanced analgesic effects.[14]

In light of this evidence, research has been extended to other forms of pain, including chronic pain and headaches, and stress management. Further studies should elucidate how these virtual effects translate to the outside world, and whether VR will be a viable replacement for pharmacological agents.[12,15,16]

WHAT ELSE CAN WE LEARN FROM VR?

Although VR demonstrates the potential to directly benefit patients, it can also indirectly impact them. Education of medical doctors places heavy emphasis on competency, proficiency, and resource usage efficiency. The implementation of VR has increasingly been a new focus of schools and hopsitals in an effort to continuously improve their teaching methods.[17,18]

Currently, surgical students who require supervision and guidance during their first surgeries frequently extend the total surgical time and consequently increase surgical complications.[19] It is suggested that these consequences can be avoided through the use of VR-based education. Simulations may allow trainees to refine techniques through visualization and motion practice in a controlled teaching environment, thereby reducing the likelihood of error during live surgery. Studies demonstrate that teaching laparoscopic and gastrointestinal surgeries through VR is both cost-effective and results in faster operative times, fewer errors, and more competent and independent trainees.[18,19]

However, though these are encouraging preliminary observations, there is no conclusive evidence that VR should replace supervised practice. Snyder et al. compared performance of students trained with a pre-recorded VR simulation against those with human supervision and discovered that while VR reduced basic errors similar to human supervision, human supervision provided more detailed feedback