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EDITORIAL

Pain Management in Physiotherapy: Is Virtual Reality the New Tool We've Been Waiting For?

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ABSTRACT

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Introduction

Pain rehabilitation is undergoing a profound transformation. For much of modern physiotherapy's history, pain was managed through a combination of manual therapy, exercise prescriptions, and various forms of patient education. These interventions remain cornerstones of practice, but the field has been steadily moving toward a more comprehensive understanding of how pain emerges, how it persists, and what it takes to modulate it effectively. The convergence of pain neuroscience, perceptual science, and immersive technologies has opened a new chapter in rehabilitation—one in which pain is increasingly understood as an experience that can be reshaped. Among these technological innovations, virtual reality (VR) has rapidly become one of the most intriguing and potentially transformative tools available to clinicians. The question is no longer whether VR has clinical value, but how it can be integrated meaningfully, responsibly, and effectively into physiotherapy practice.

Physiotherapists today operate within an updated conceptual model of pain—one that views pain not as a direct marker of tissue injury but as an emergent property of the nervous system, shaped by sensory input, cognitive processes, emotional states, threat perception, and environmental context. This paradigm shift is largely anchored in Melzack's neuromatrix theory, which reframed pain as a product of a dynamically interacting network of brain regions responsible for creating the experience of the body and of threat.[16] Modern pain neuroscience education (PNE) has extended this model into practice, helping both clinicians and patients understand the mechanisms behind pain persistence and modulation.[12,18] However, while education, exercise, and hands-on techniques can influence movement, belief systems, and coping strategies, they do not always directly impact the perceptual and cortical processes that underlie pain. This is where VR begins to offer unique therapeutic possibilities.

Virtual reality is not simply a novel interface; it is a perceptual technology capable of modifying how patients experience themselves, their bodies, and their environment. Immersive VR can shift attention away from nociceptive signals, recalibrate distorted body maps, reduce perceived threat, and gradually restore confidence in movement. These mechanisms have been demonstrated in experimental and clinical research exploring VR's effects on acute pain, persistent pain, and fear-avoidant movement patterns.[13,27,1,17,3,25] The immersive quality of VR—its ability to capture visual, auditory, and proprioceptive attention—appears to activate descending inhibitory pathways, change cortical activation patterns, and temporarily shift the perceptual context in which pain is interpreted. VR therefore aligns naturally with physiotherapy's current understanding of pain as a biopsychosocial and perceptually constructed phenomenon[1].

What makes VR particularly compelling in physiotherapy is the way it integrates with familiar clinical concepts. Physiotherapists already work with motor learning principles, graded exposure, sensory discrimination, and embodied movement retraining. In many ways, VR amplifies these concepts. When a patient with chronic low back pain hesitates to bend forward due to fear, VR can create scenarios in which the same movement is performed within a safe, engaging, gamified environment. Research shows that such immersive exposure can reduce kinesiophobia and improve functional movement more rapidly than conventional exposure alone.[20]Patients often perform movements in VR that they would never consider attempting in the clinic. The perceived safety, novelty, and enjoyment of VR become therapeutic mechanisms in themselves.

The correction of distorted body maps—an essential component of chronic pain rehabilitation—is another domain where VR offers unique advantages. Chronic pain is frequently associated with alterations in cortical representation. For example, patients with chronic low back pain often demonstrate smudging of the somatosensory cortex, while individuals with complex regional pain syndrome (CRPS) show disrupted body ownership and distorted limb representation. VR can present patients with a visually coherent and pain-free representation of their body or limb, enabling the nervous system to update and reorganize distorted cortical maps. Studies in CRPS, phantom limb pain, and chronic musculoskeletal pain have shown that VR-based visual feedback can reduce pain intensity and improve motor function by altering these cortical representations.[20,24,14] These effects parallel, and in many cases surpass, the benefits of traditional graded motor imagery (GMI) and mirror therapy.

Although VR shares conceptual territory with GMI, it also extends it. The classic sequence of GMI—laterality discrimination, explicit motor imagery, and mirror therapy—is designed to gradually reintroduce normal movement representations into the nervous system. However, VR functions as a potential "fourth stage," offering full-body embodiment, real-time visual-proprioceptive recalibration, and immersive movement experiences that are not bound by the physical limitations of the clinic. Recent narrative and experimental studies suggest that VR-based GMI enhances patient engagement, increases behavioral activation, and may accelerate neurocognitive changes associated with pain reduction.[8]This integration is not merely additive; it is potentially synergistic.

The expanding evidence base for VR is compelling. Systematic reviews and meta-analyses have shown that VR can reduce pain across a range of conditions, including chronic musculoskeletal pain, postoperative pain, osteoarthritis, and neuropathic pain.[3,10,4,26] One large review encompassing multiple VR applications found that immersive VR significantly reduced pain intensity and improved functional outcomes compared to standard therapy and multimodal rehabilitation alone.[3] Randomized controlled trials have demonstrated reductions in acute pain during physiotherapy sessions, enhanced tolerance for movement-based tasks, and meaningful decreases in pain-related fear.[4,10] Importantly, VR appears to be effective for both short-term symptom modulation and longer-term functional rehabilitation when integrated into structured treatment programs.

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Chronic low back pain represents one of the most studied areas of VR-based physiotherapy. Patients engaged in VR movement tasks or VR-enhanced exercise programs show reductions in kinesiophobia, improved lumbar movement patterns, and decreased pain levels.[25] In osteoarthritis, VR has been shown to improve joint mobility, enhance exercise adherence, and reduce perceived effort .[10] For patients undergoing orthopedic surgery, VR has been used pre- and post-operatively to reduce pain, anxiety, and opioid consumption.[26] In cardiac surgery populations, VR-based relaxation and breathing environments significantly lowered postoperative pain and distress.[11] These findings highlight VR's cross-disciplinary potential, suggesting that it may become a standard adjunct in many rehabilitation settings.

However, VR remains a tool—not a standalone treatment. Without clinical reasoning, tailored progression, and careful monitoring, VR risks becoming a superficial distraction. Physiotherapists must determine which patients are suitable candidates for VR-based interventions. Individuals with severe cybersickness, vestibular disorders, or certain psychiatric conditions may require special consideration or alternative approaches. Dosing is also essential. Overexposure can induce fatigue, dizziness, or sensory overload. Underexposure may result in minimal therapeutic effect. The therapist's role involves fine-tuning these parameters and contextualizing VR as one component within a multimodal strategy involving exercise progression, education, manual therapy, and behavioral coaching.

The therapeutic use of VR also highlights the shift from passive care to perceptual rehabilitation. Passive modalities often fail to create lasting change because they do not address the central processes that maintain chronic pain. VR, by contrast, alters perception, belief, and expectation. It targets threat appraisal, modifies limb ownership, changes movement confidence, and enhances cognitive flexibility. As such, VR aligns with and strengthens the principles of pain neuroscience education. Research has shown that patients who understand the mechanisms of pain respond better to movement-based interventions, including VR; education "primes" the central nervous system for new perceptual experiences.[12,16] Thus, VR and PNE may represent a highly compatible pairing in modern rehabilitation.

Looking toward the future, it is likely that VR will become increasingly integrated into physiotherapy and pain clinics worldwide. Emerging developments include AI-enhanced rehabilitation platforms capable of tailoring VR tasks to individual patients based on real-time performance data, advanced haptic suits that provide realistic proprioceptive and tactile feedback, and motion-tracking systems that quantify joint range of motion with unprecedented accuracy. Researchers are exploring the integration of EEG and functional near-infrared spectroscopy (fNIRS) with VR to examine how brain activation patterns change during movement and pain, opening the door to neurofeedback-assisted rehabilitation. These innovations could fundamentally reshape both assessment and treatment. Yet technological advancement must be matched with clinical wisdom. Evidence-based protocols, standardized guidelines, and therapist training programs are urgently needed. VR must be implemented ethically, safely, and with a deep understanding of the biopsychosocial nature of pain. Physiotherapists who master VR will not replace traditional practice; rather, they will expand what physiotherapy can achieve. VR may become what manual therapy or exercise therapy once represented in earlier decades: a major leap forward in the profession's evolution.

Ultimately, virtual reality does not need to replace the established pillars of physiotherapy to be valuable. Its power lies in how it complements them. VR engages the perceptual and cognitive mechanisms that our hands, our words, and our exercises often struggle to influence directly. It offers new ways to restore agency, reduce fear, and reshape how patients perceive their bodies. When applied with clinical reasoning and grounded in contemporary pain science, VR becomes not merely a technological novelty but a meaningful evolution in rehabilitation—one that is immersive, personalized, and deeply patient-centered. Virtual reality is not a trend. It is a new dimension of physiotherapy practice. And for many patients living with persistent pain, it may indeed be the tool they—and we—have been waiting for.

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