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Virtual reality therapy for myofascial pain: Evolving towards an evidence-based non-pharmacologic adjuvant intervention

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ABSTRACT

Myofascial pain syndrome (MPS) is a highly prevalent and burdensome cause of pain globally, representing a major focus of chronic pain management. Management of MPS is highly variable, with therapies ranging from interventional approaches to physical therapy. Virtual reality (VR) is a novel form of therapy being actively explored as an adjuvant to procedural sedation in the acute pain setting, and increasingly as a means of chronic pain management through programs that facilitate pain education, physical therapy and mindfulness, among other approaches. However, to date, there are minimal clinical studies assessing VR therapy within the context of MPS treatments. Given the existing volume of work published in the acute pain setting and the translational work exploring VR and neuroplasticity in chronic pain, we make the case here that it is an appropriate time to consider exploring VR therapy as a non-pharmacological adjuvant treatment for MPS.

Myofascial pain syndrome (MPS) is a musculoskeletal condition characterized by hypersensitive and irritable myofascial trigger points (MTrPs) present in taut bands of skeletal muscle tissue. It has a lifetime prevalence approaching 85% in the general population, with the estimated prevalence of active MTrPs managed in specialty clinics ranging from 46% to as much as 90% [1,2]. Consequently, MPS is a common contributor to chronic pain, yet its pathophysiology remains relatively poorly understood, with likely etiologies stemming from trauma, deconditioning, spinal pathology, repetitive misuse or strain. MPS is considered to be among the leading causes of musculoskeletal pain, translating to one of the leading costs of illness in developed countries like Canada [1,3]. The mean prevalence of MPS in adults 30–60 years is reported to be around 37% in men and 65% in women, however this reaches 85% in the elderly population across both sexes [4]. As the world population ages, with the ratio of people 65 years or older to those aged 15–64 years projected to double in developed countries by 2050, MPS is likely to only become an increasingly prevalent culprit of chronic pain [5]. Thus, we posit that MPS represents a major burden for pain practitioners and society, in general.

Approaches to management of chronic pain associated with MPS are varied, including injections, manual and massage therapy, physical therapy, dry needling, stretching, laser therapy and electrical stimulation, individually and in assorted combinations [6–9]. Regarding trigger point injections (TPIs) in particular, there exists a wide variety of opinions pertaining to optimal technique and even efficacy in general, as many practitioners consider dry needling as effective as TPIs using local anesthetic [9]. A 2009 systematic review by Scott et al. examined 15 randomized control trials and determined that there was no clear evidence of either benefit or ineffectiveness of TPIs compared to other treatments for musculoskeletal pain [9]. Many chronic pain interventions have demonstrated fair to strong efficacy in various clinical contexts, such as facet joint injections and medial branch blocks for facet arthropathy and epidural steroid injections in short-term radicular pain, particularly in the setting of low back pain [10,11]. In comparison, the common interventions for MPS such as TPIs, cupping and dry needling have lacked both consistent, high-quality evidence of efficacy as well as agreement among providers regarding application practices [6,9,10]. As the current arsenal of treatments for MPS is wide-ranging and applied somewhat inconsistently, it behooves practitioners treating MPS to continue exploring alternate or updated methods for approaching management.

Virtual reality (VR) has been increasingly implemented in recent years in both acute and chronic pain settings. VR presents the patient with a simulated experience that employs pose tracking and three-dimensional near-eye displays to provide the immersive feel of a virtual world. In the setting of acute pain, the simulation often provides a more peaceful environment that distracts the patient from a stimulus. In the setting of chronic pain, the simulation is likely to be more variable, but in addition to providing a distraction method during procedures, may include a simulated game to facilitate movement, an exploration of a simulated nervous system to provide pain education, a remote location to practice deep breathing exercises, or a combination of all the above. Nonetheless, there does not currently appear to be any clear standardization or protocolization in the application of VR for management in either the acute or chronic pain settings. A handful of studies have examined the benefit of VR simulation as a distraction technique to modulate acute pain during procedures [12], or as an alternative to conventional exercise regimens in physical therapy settings [13], however there is a paucity of research considering VR as a non-pharmacological independent or adjuvant treatment for MPS.

Numerous studies on VR in acute pain have delved into its use in a variety of procedural scenarios, with the literature demonstrating benefits stemming from distraction, and facilitating an immersive experience that can reduce pain, anxiety and anger levels [14]. VR has found utility in a range of situations from pediatric needle procedures, to labor contractions and episiotomy repairs, to burn dressing changes and wound

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debridement, with studies reporting as much as a 25% decrease in pain scores during the procedure compared to control [15–17]. Although findings have been varied regarding decreases in opioid use, numerous studies have reported higher patient satisfaction scores with VR use versus no distraction-based intervention [15,17].

Exploration of VR in the clinical treatment of chronic pain has been less consistent and more varied when compared against studies in acute pain settings, where it is primarily implemented as a short-term distraction tool. Findings in chronic pain have ranged from minimal benefit of VR single therapeutic sessions [18] to effective reduction of chronic pain following longer-term VR exposures [19]. Long-term neuroplasticity has also been theorized as a target for the beneficial effects of VR implementation in chronic pain [20]. Translational VR studies have evaluated this etiology of relief in the management of MPS, suggesting that long-term VR use can facilitate changes in sensory and motor brain regions that provide lasting improvements in pain symptoms, and various studies have proposed ongoing pain relief from mechanisms related to "gate theory control" [21–23]. Further translational studies have postulated measurements of these changes, including the modulation of late perceptual pain processing and pre-perceptual brain responses to pain on EEG [24,25]. Related neurophysiological responses involved in studies exploring these changes include lower breathing frequency as well as reduced heart rate variability following noxious stimuli [25]. Studies examining VR interventions in phantom limb pain have also explored their impact on a "sense of embodiment," perhaps enhancing a sense of agency and ownership over the body as another mechanism to reducing chronic pain; this is theorized to involve the realignment of a mismatch between the physical being and the mental projection of one's physical being [26,27]. Investigating a link specifically between MPS symptoms and perceived sense of ownership or agency over one's body could further VR's potential therapeutic application in MPS.

Within the field of physiotherapy, regimens of VR are actively being studied and compared to conventional approaches. The combination of exercises for strength and flexibility, along with mindfulness, have been implemented as part of the VR sessions in existing studies that overlap with conventional physical therapy (PT) programs [19,20]. Certain protocols have demonstrated noninferiority of consistent VR-based exercise programs in comparison to standard exercise and therapy regimens [13,28]. VR has already been implemented for rehabilitation in patients with neurological disability, as well as for early mobilization in post-operative cardiac surgery patients, with promising effect [29,30]. Within the field of PT as it relates to MPS, VR has the potential for further integration as it is becoming increasingly accessible and lower cost to implement [29]. For certain individuals, it may function as an adjuvant of physical activity that is more engaging in the long term than following standard home exercise plans.

Nonetheless, despite promising findings in relation to effects on neuroplasticity and improving motivation and participation in exercise, VR has not independently been clinically assessed against or as an adjuvant to conventional interventional techniques such as TPIs as a feasible therapy in MPS management. Future trials could start by assessing the effect of regular, scheduled VR therapeutic sessions on myofascial pain outcomes versus sham VR, for example. A similar trial conducted by Garcia et al. compared the EaseVRx program against sham VR for chronic low back pain in 179 patients over the course of 56 daily sessions [31]. The VR program was superior to sham VR for primary outcomes including reduced pain intensity and pain-related interference with activity, mood, sleep and stress, but not for pain catastrophizing, pain self-efficacy, pain acceptance, or prescription opioid use. The same team recently expanded upon this study to assess durability of their findings, with 50% of participants maintaining clinically meaningful reductions in pain interference 18 months post-intervention [32]. This randomized control trial represents the start of chronic pain-specific trials aimed at FDA approvable digital therapeutics for certain diagnoses. Limitations of the study include an inherent bias toward more technologically savvy patients for recruitment and reliance on patient-reported data for both initial establishment of symptoms and diagnoses, as well as for assessing pain response. Future explorations may eventually involve comparison of VR with standard of care therapies utilized by pain practitioners, and certain methodological limitations may be more easily minimized as similar studies become more commonly employed and refined. However, the first step forward is continuing the evolution of the scope in research involving VR simulation beyond its use as a distraction tool in pain medicine with further focus on it as a viable treatment modality for specific chronic pain diagnoses.

Overall, the question we posit is whether VR has a future place as a nonpharmacological adjunct alongside current standard-of-care treatments or if it could even potentially be effectively used in lieu of them. The past decade has shown a great deal of investment for VR as a tool in the acute pain medicine, pain psychology and physiotherapy settings that is suggestive of VR's future utility for MPS. As demonstrated in recent studies, VR has shown potential for therapeutic application in chronic low back pain, however has yet to see similar exploration in MPS, where common interventions continue to lack consistent evidence of efficacy as well as consensus among providers regarding best applications [31,32]. Thus, with MPS being a cause of chronic pain that is simultaneously highly prevalent and burdensome but also lacking consistency in evidence-based utilization of interventions, it seems now is an appropriate time to transition resources devoted to studying VR as a therapeutic option.

Declaration of competing interest

Rohan Jotwani is a Scientific Advisor to *Medis Media*, but he owns no shares/financial interests with the organization and receives no funding from the organization.

Erik Wang has no conflicts of interest to report.

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Erik F. Wang
Department of Anesthesiology, Weill Cornell Medicine/NewYork-Presbyterian, New York, NY, USA

Rohan Jotwani*
Department of Anesthesiology, Weill Cornell Medicine, New York, NY, USA

* Corresponding author. Weill Cornell Medicine, 525 East 68th Street, Box 124, NY, 10065, USA.
E-mail address: roj9068@med.cornell.edu (R. Jotwani).