Chronic Pain: Restoring the Central Nervous System “Body Image” with Virtual Reality

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1 OBJECTIVES

Chronic pain, such as low-back pain and facial pain, is a highly disabling condition affecting approximately 20% of the European adult population and severely degrading people’s quality of life (Baykara et al, 2013; Weiss et al, 2017). In both conditions, not every patient respond to pharmacological treatment, leading to the situation of chronic pain. Since pain refers to a multimodal experience, the chronicity of pain can have a dramatic impact on various aspects of people’s life such as vitality, social functioning, general health and consequently role limitations due to physical or mental health (Leadley et al, 2014). Moreover, it has been demonstrated that chronic pain can lead to a somatic disperception, meaning a substantial mismatch between the sensation of the affected body part and its actual physical state (Flor et al, 1997; Moseley et al, 2008; Forderreuther et al, 2004; Lewis et al, 2007). Since the clinical rating of pain relies on the subjective reports of patients, a distorted body image could lead to an incorrect pain rating, which could in turn lead to an incorrect pain treatment and to the risk of drug abuse. There is thus the need for the development of alternative non-pharmacological treatments of chronic pain to improve patients’ quality of life, reduce pain and avoid the risk of drug abuse.

Virtual reality (VR) constitutes an enriched environment with augmented multiple sensory feedbacks (auditory, visual, tactile) engaging several cortical and subcortical neuronal circuits that potentiate patient’s learning and recovery, including the mirror neuron system. Mirror neurons are involved in the mechanisms of perception/action coupling and are fundamental in the processes of understanding actions of other people and learning new skills (Rizzolatti et al, 2008). VR would thus constitute a good candidate to help patients to augment their own movements and body position perception (Harvie et al, 2017) in order to regain a correct body image. The objectives of our study were thus to use VR-based training in chronic low-back pain and facial pain to improve patient’s quality of life, to reduce pain sensations, and to improve patients’ mood and functional abilities.

2 METHODS

Patients with chronic low-back pain (n=5) and facial pain (n=5) were included. Treatment consisted in a 6 week-neurorehabilitative training (2 sessions a week; total number of sessions = 12) using virtual reality (VRRS-EVO, Khymeia group, Noventa Padovana, Italy). During training, patients were taught to execute correct movements with the painful body parts (back or face) to regain a correct body image, based on the augmented multisensory feedback (auditory, visual) provided by the VRRS (Figure 1).

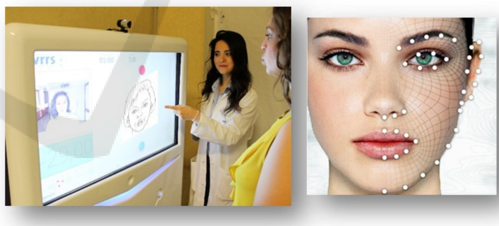

Figure 1: Virtual reality setting for facial pain rehabilitation.

Before and after treatment, patients underwent the following detailed investigations: neurological exam; neuro-psychological evaluation testing cognitive functions (memory, attention, executive functions), personality traits (Minnesota Multiphasic Personality Inventory Test), quality of life (QoL, SF-36 questionnaire) and mood (Beck Depression Inventory); pain ratings (Numeric Rating Scale (NRS), McGill Pain Questionnaire, Brief Pain Inventory (Short Form)); and sensorimotor functional abilities (Roland and Morris Disability Questionnaire

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(RMDQ), Penn Facial Pain Scale (PFPS)). After treatment, patients were also asked to indicate their subjective impression of change with respect to baseline condition using a 7-point scale (Global Impression of Change, GIC).

3 RESULTS

Our preliminary results showed improvements of QoL in the domains of role limitations due to physical health and emotional issues, social functioning and pain (Figure 2). Moreover, every patient reported a reduction in pain rating scores (mean numerical rating scale (NRS) score before treatment: 5,7 ± 2,3; after treatment: 3,4 ± 2,4; $p<0.05$). Data showed a significant increase in mood levels (BDI, see Figure 3) and functional scales (RMDQ pre: 10.3 ± 2.1; post: 9 ± 1.7; PFPS pre: 86 ± 32.5; post: 63.5 ± 31.5; $p<0.05$). These functional improvements correlated with the perceived reduction of pain sensation (RMDQ: R= 0.67; PFPS: R=0.74; BDI: R=0.75; $p<0.05$). Our data also showed a reduction of analgesic drugs intake. All these results were supported by the subjective impression of general improvement reported by every patient after treatment (GIC scale).

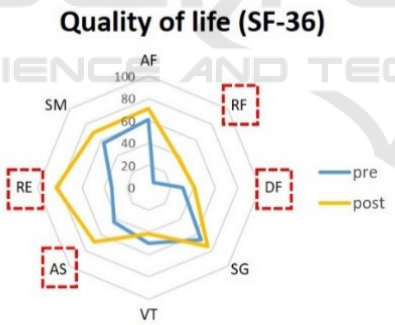

Figure 2: Mean QoL scores before (blue) and after (orange) treatment in all patients.

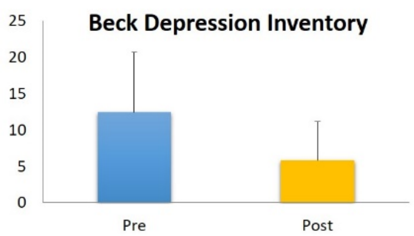

Figure 3: Mean scores (+ standard deviations) of Beck Depression Inventory before (left) and after (right) treatment in all patients.

4 DISCUSSION

This non-pharmacological approach of chronic pain was able to improve patients' QoL, to reduce painful sensations, to improve mood and to improve patient's functional abilities. It is noteworthy that this treatment was also able to reduce drug intake. Although these data need to be confirmed with a controlled-study involving a higher number of patients, our preliminary data showed that this virtual reality-based treatment aimed at restoring a correct body image had beneficial effects on the multi-dimensional aspects of pain.

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