An overview of biofeedback techniques in mechanical low back pain: effects on sensory integration of balance

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Abstract

Low back pain is a common musculoskeletal disorder involving the lumbar spine. It affects almost 80% of the world's population and is associated with functional limitations. The reported global prevalence ranges from15–30%. Postural control involves processing the information from sensory stimulus derivative of vestibular, visual, and somatosensory systems in a coordinated manner to precisely regulate center of mass and body positioning. Failure of one or more of these systems, or incorrect processing of sensory information leads to instability or risk of fall. Low back pain can also modify the sensory input for postural control. Biofeedback can be utilized to assist "down-train" elevated muscle activity or to "up-train" weak or inhibited, muscles. Clinicians can use biofeedback to determine if patients are able to relax and evaluate psychophysiological reactions of muscles. Using biofeedback, patients can be educated about physiological processes and how biopsychosocial factors can interact causing recurrent complaints of pain.

Keywords: Surface electromyography biofeedback, Mechanical back pain, sensory integration of balance, postural stability.

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Introduction

Mechanical low back pain is one of the most common musculoskeletal disorders around the globe and a leading cause of disability. It excludes back pain due to neoplasms, inflammatory arthropathies or any pain from a source which is not located in the spine.[1]

The main cause is thought to be the modification in lumbar spine kinematics that relates to structural changes such spondylolisthesis, spondylosis, etc. Like the other conditions, low back pain is a manifestation of some causes and risk factors, including structural causes with origination from arthritic, muscular, or discogenic routes , which by fact is the commonest cause of LBP. There are many risk factors for backpain which are variable and population-specific. Sedentary lifestyle is one of the leading risk factors for low back pain.[2] Mechanical back pain can be classified as acute, subacute, and chronic

The global prevalence of chronic low back pain is estimated to be 15–30%.[3] It equally affects all genders, races, and ethnicities. It is estimated that in Pakistan lumbar discomfort due to low back pain affects 55% of young adults.[4] The incidence of lumbar mechanical back pain is highest in the third decade of life and increases till the sixth decade.[5]

Postural control involves processing information from sensory stimuli derivative of the vestibular, visual, and somatosensory systems in a coordinated manner to precisely regulate the position of body and center of mass. Failure of one or more of these systems, or incorrect processing of sensory information leads to instability and a higher risk of a fall. The sensory input to postural control can be altered by LBP[6] which causes lumbar instability due to core muscle weakness in chronic low back pain patients. It also leads to hypermobility of lumbar spine which further deteriorates the internal homeostasis and motor control of lumbar spine. Moreover, chronic low back pain also leads to impairment in postural stability, loss of dynamic balance, and functional mobility reduction in the elderly. Therefore, rehabilitation and management of postural instability should not be ignored during management of low back pain in older patients.[7]

Biofeedback

Biofeedback is a technique in which biological information is digitalized and sent back to a patient[8]. Biofeedback was initially used mostly for diagnostic purposes only but recently, it can also be used as a treatment modality for a variety of disorders including chronic low back pain, problems with spinal biomechanical disorders.[9]

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Types of biofeedback used in rehabilitation

Physiological biofeedback

- **Surface electromyography biofeedback**

Surface electromyography biofeedback (SEMG) is one of the biofeedback modalities used for treatment and diagnostic purposes. SEMG is a measure of the electrical activity of the muscle. It measures the muscle tension in the form of visual waveforms or graphs and auditory signals once the patient has achieved maximal voluntary contraction in the desired muscles. In physiological biofeedback, other types such as.

- **Respiratory biofeedback** is administered by converting breathing to auditory and visual signals by using different electrodes and sensors. This type has been used for the training of respiratory muscles such as diaphragm.

- **Cardiovascular biofeedback** can also be used to give real time biofeedback in the form of heart rate and heart rate variability.

In musculoskeletal rehabilitation SEMG biofeedback is preferentially used for the relaxation of over-toned muscles and for the up-training of the weak muscles.

Biomechanical Biofeedback

Biomechanical feedback involves measurement of the movement, postural sway, and other forces that are generated by the body. Dynamic posturography, force plates, and camera-based biofeedback units can be used for biofeedback. It is the more complex form of biofeedback as compared to other forms such as physiological biofeedback.[8]

Effects of biofeedback

People with mechanical low back pain have poor stabilization of posture. They also show deficits in the sensory integration of balance. Biofeedback training to maintain their balance and improve sensory integration can be beneficial for the maintenance of overall postural homeostasis.

Latest studies have established that the pain intensity is directly associated with the postural sway and improvement in sensory integration and postural stability can directly affect the pain and disability in nonspecific low back pain.[10] Biofeedback while performing therapeutic exercise regimens can be beneficial in improving overall postural stability and directly sensory integration of balance

Biofeedback is an important modality not only in training of the muscles but it also effective in the cognitive behavioural treatment of somatosensory disorders because it improves overall control of the psychological and physiological processes that are involved in such disorders.[9]

SEMG can be used to help "down-train" elevated muscle activity or to "up-train" weak or inhibited muscles.[11] The walking exercise with biofeedback which in turn activates core muscles showed positive effects in patients with chronic LBP. Specifically, it is speculated that deep muscles contraction during walking exercises is beneficial for muscle activity, deep muscular strength, and lumbar function.[12] Biofeedback can be used by clinicians to establish whether patients are able to relax and to assess the psychological reactions of patients to stressors. Education and understanding of relationship between stress, emotions, pain, and physiological processes which might enhance the adherence of patients to psychological pain management.

Conclusion

Different types of biofeedback for the activation of the desired somatosensory components of the musculoskeletal systems are available. SEMG can be used in orthopaedic and neuromuscular rehabilitation. SEMG is cost effective and easy to incorporate in the rehabilitation plans of different conditions. It is theorized that improving neuromuscular control via bio-feedback training enables a person to have enhanced postural control via improvement in biomechanical maintenance of posture through proper somatosensory activation of muscles and proprioceptive feedback. There is a need to explore and integrate this modality in the management of mechanical low back pain patients in Pakistan.

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