

# ORIGINAL RESEARCH

## EFFECTIVENESS OF A MOTOR CONTROL THERAPEUTIC EXERCISE PROGRAM COMBINED WITH MOTOR IMAGERY ON THE SENSORIMOTOR FUNCTION OF THE CERVICAL SPINE: A RANDOMIZED CONTROLLED TRIAL

Amanda Hidalgo-Peréz, PT<sup>1</sup>  
Ángela Fernández-García, PT<sup>1</sup>  
Ibai López-de-Uralde-Villanueva, PT, Msc<sup>1-4</sup>  
Alfonso Gil-Martínez, PT, Msc<sup>1-4</sup>  
Alba Paris-Alemaný, MD, PT, Msc<sup>1-4</sup>  
Josué Fernández-Carnero, PT, Msc, PhD<sup>1-5</sup>  
Roy La Touche, PT, MSc, PhD<sup>1-4</sup>

### ABSTRACT

**Background:** Motor control therapeutic exercise (MCTE) for the neck is a motor relearning program that emphasizes the coordination and contraction of specific neck flexor, extensor, and shoulder girdle muscles. Because motor imagery (MI) improves sensorimotor function and it improves several motor aspects, such as motor learning, neuromotor control, and acquisition of motor skills, the authors hypothesized that a combination of MCTE and MI would improve the sensorimotor function of the cervical spine more effectively than a MCTE program alone.

**Purpose:** The purpose of this study was to investigate the influence of MI combined with a MCTE program on sensorimotor function of the craniocervical region in asymptomatic subjects.

**Study Design:** This study was a single-blinded randomized controlled trial.

**Methods:** Forty asymptomatic subjects were assigned to a MCTE group or a MCTE + MI group. Both groups received the same MCTE program for the cervical region (60 minutes), but the MCTE + MI group received an additional intervention based on MI (15 minutes). The primary outcomes assessed were craniocervical neuromotor control (activation pressure value and highest pressure value), cervical kinesthetic sense (joint position error [JPE]), and the subjective perception of fatigue after effort.

**Results:** Intra-group significant differences were obtained between pre- and post interventions for all evaluated variables ( $p < 0.01$ ) in the MCTE + MI and MCTE groups, except for craniocervical neuromotor control and the subjective perception of fatigue after effort in the MCTE group. In the MCTE + MI group a large effect size was found for craniocervical neuromotor control ( $d$  between -0.94 and -1.41), cervical kinesthetic sense ( $d$  between 0.97 and 2.14), neck flexor muscle endurance test ( $d = -1.50$ ), and subjective perception of fatigue after effort ( $d = 0.79$ ). There were significant inter-group differences for the highest pressure value, joint position error (JPE) extension, JPE left rotation, and subjective perception of fatigue after effort.

**Conclusion:** The combined MI and MCTE intervention produced statistically significant changes in sensorimotor function variables of the craniocervical region (highest pressure value, JPE extension and JPE left rotation) and the perception of subjective fatigue compared to MCTE alone. Both groups showed statistically significant changes in all variables measured, except for craniocervical neuromotor control and the subjective perception of fatigue after effort in the MCTE group

**Level of Evidence:** 1b

**Key Words:** Cervical disorders, motor imagery, motor control, therapeutic exercise.

<sup>1</sup> Department of Physiotherapy, Faculty of Health Science, The Center for Advanced Studies University La Salle, Universidad Autónoma de Madrid, Aravaca, Madrid, Spain

<sup>2</sup> Research Group on Movement and Behavioral Science and Study of Pain, The Center for Advanced Studies University La Salle, Universidad Autónoma de Madrid, Aravaca, Madrid, Spain

<sup>3</sup> Institute of Neuroscience and Craniofacial Pain (INDCRAN), Madrid, Spain

<sup>4</sup> Hospital La Paz Institute for Health Research, IdiPAZ. Madrid, Spain

<sup>5</sup> Department of Physical Therapy, Occupational Therapy, Rehabilitation and Physical Medicine, Universidad Rey Juan Carlos, Alcorcón, Madrid, Spain

The authors report no conflicts of interest.

### CORRESPONDING AUTHOR

Roy La Touche  
Facultad de Ciencias de la Salud  
Centro Superior de Estudios Universitarios  
La Salle.  
Calle La Salle, 10  
28023 Madrid  
SPAIN  
Telephone number: + 34 91 7401980 (EXT.256)  
E-mail address: roylatouche@yahoo.es