Scandinavian Journal of Pain 12 (2016) 74–83

Contents lists available at ScienceDirect

Scandinavian Journal of Pain

journal homepage: www.ScandinavianJournalPain.com

Original experimental

Influence of paravertebral muscles training on brain plasticity and postural control in chronic low back pain

Hugo Massé-Alarie [a,*], Louis-David Beaulieu [a], Richard Preuss [b], Cyril Schneider [a,c]

[a] Research Center of CHU de Québec, Neuroscience Division, Clinical Neuroscience and Neurostimulation Laboratory, Quebec City, QC, Canada
[b] McGill University, Constance-Lethbridge Rehabilitation Center-CRIR, Montreal, QC, Canada
[c] Department of Rehabilitation, Faculty of Medicine, Université Laval, Quebec City, QC, Canada

HIGHLIGHTS

- Isometric vs. global exercises of multifidus muscles had different effects.
- Isometric exercise influenced brain plasticity and fastened postural adjustment.
- Changes persisting after 3-week training and long-term effects are questioned.

ARTICLE INFO

Article history:
Received 18 November 2015
Received in revised form 19 February 2016
Accepted 17 March 2016

Keywords:
Cortical motor plasticity
Anticipatory postural adjustment
Multifidus
Training
Chronic low back pain

ABSTRACT

Background and purpose: Isometric activation (ISOM) of deep multifidi muscles (MF) can influence postural adjustments and primary motor cortex (M1) function in chronic low back pain (CLBP). In order to better understand how ISOM impacts on CLBP condition, the present study contrasted ISOM after-effects on M1 function, MF postural activation and pain with another training, the global activation of paravertebral muscles (GLOB, hip extension). The main objective of this study was to compare the effects of ISOM and GLOB (3-week training each) on MF postural activation and M1 function in a CLBP population.
Methods: Twenty-four people with CLBP were randomly allocated to ISOM and GLOB groups for a 3-week daily practice. Pre/post-training after-effects were assessed by the onset of superficial MF (MF-S) activation during ballistic limb movements (bilateral shoulder flexion in standing; unilateral hip extension in prine lying), MF-S corticomotor control tested by transcranial magnetic stimulation of M1, and assessment of pain, kinesiophobia and disability by standardized questionnaires.
Results: Both ISOM and GLOB improved pain and disability. However, only ISOM influenced M1 function (decreased corticospinal excitability and increased intracortical inhibition), fastened MF-S postural activation and decreased kinesiophobia.
Conclusions: Changes of corticospinal excitability and of MF-S postural adjustments suggest that ISOM better influenced brain plasticity. Future studies should further test whether our novel findings relate to an influence of the exercises on the lumbopelvic control of different muscles and on cognitive function. Clinically, individual's evaluation remains warranted before prescribing one or the other of these two conventional exercises for reducing pain.
Implications: This original study presents how motor control exercises can influence brain plasticity and postural control in chronic low back pain. This knowledge will impact on the decision of clinicians to prescribe specific exercises with a view of improving motor control in this musculoskeletal condition.
© 2016 Scandinavian Association for the Study of Pain. Published by Elsevier B.V. All rights reserved.

1. Introduction

Chronic low back pain (CLBP) is common [1] and affects up to 10% of people worldwide [2,3]. The impairment of posturo-motor control of trunk muscles has been proposed as a factor contributing to the persistence of pain [4]. In line, studies reported an overactivation of superficial paravertebral muscles in some individuals with CLBP [5–8] and a delay of the anticipatory postural adjustments

DOI of refers to article: http://dx.doi.org/10.1016/j.sjpain.2016.04.004.
* Corresponding author at: Centre de recherche du CHU de Québec, Neuroscience Division, RC-9800, 2705 Blvd. Laurier, Quebec City, Canada G1V 4G2. Tel.: +1 418 525 4444x47539; fax: +1 418 654 2753.
E-mail address: hugo.masse-alarie.1@ulaval.ca (H. Massé-Alarie).

http://dx.doi.org/10.1016/j.sjpain.2016.03.005
1877-8860/© 2016 Scandinavian Association for the Study of Pain. Published by Elsevier B.V. All rights reserved.

Table 1
Descriptive characteristics of participants at baseline (mean ± SD).

Groups	GLOB	ISOM	*p*
Participants (*n*)	11	11	–
Gender (M:F)	8:3	6:5	0.66[a]
Age (years)	45.4 ± 18.1	35.1 ± 11.4	0.13
Height (cm)	169.7 ± 7.5	174.1 ± 11.4	0.30
Weight (kg)	76.0 ± 19.8	78.1 ± 14.2	0.78
BMI (kg/m^2)	26.2 ± 6.1	25.6 ± 2.7	0.75
GPAQ (METS)	2640.0 ± 2432.7	3265.5 ± 2185.4	0.53
Sedentarity (h)	8.9 ± 2.1	8.5 ± 2.7	0.66
Pain duration (mo)	51.6 ± 44.8	38.5 ± 23.4	0.40
Pain side (right:left)	7:4	4:7	0.40[a]

GLOB: global exercise; ISOM: isometric exercise; BMI; body mass index; GPAQ: Global Physical Activity Questionnaire; mo: months; METS; metabolic equivalent; *p*: bilateral unpaired *t*-test.
[a] Bilateral Fisher's exact test.

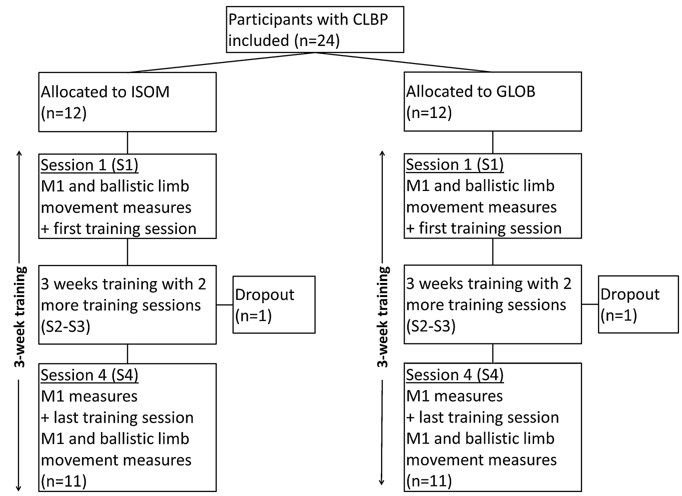

Fig. 1. Flowchart of the study design. CLBP: chronic low back pain; ISOM: isometric contraction of multifidus muscles (MF); GLOB: global activation of paravertebral muscles; M1: primary motor cortex; APA: anticipatory postural adjustment.

(APA) of some trunk muscles (usually transverse abdominis or TrA and lumbar multifidus or MF) [9–12]. Studies using transcranial magnetic stimulation (TMS) of the primary motor cortex (M1) showed that this APA delay was correlated with a shift of M1 maps [13] and concomitant to a loss of M1 inhibitory mechanism usually involved in motor planning [14]. Precisely, M1 areas controlling erector spinae and MF muscles overlapped in CLBP whereas distinct in pain-free subjects [15,16].

It was shown that a single session of isometric motor control exercises (ISOM, i.e. specific activation of deep trunk muscles) immediately reduced APA delay of the muscle trained [17,18] and that improvement persisted after a 3-week training program [19,20]. This was correlated with M1 map normalization [19] and accompanied by a reactivation of M1 inhibitory processing [21]. These improvements were not observed after a single session of global activation of trunk muscles (GLOB, maintenance of a specific posture) [22] that however significantly reduced APA delay after one-year training [23,24].

A different influence of ISOM and GLOB on APA and pain and persistence of after-effects after several training sessions could be related to a different impact on M1 plastic phenomena but this has never been tested. Studies in neuropathic pain and using noninvasive brain stimulation to influence M1 plasticity indeed showed that the level of reactivation of M1 inhibitory circuits (dynamic plastic changes) was correlated with a reduction of neuropathic pain [25]. Therefore, the primary objective of this study was to compare the effects of ISOM and GLOB (3-week training each) on MF APA and M1 function in a CLBP population. The working hypothesis was on a greater influence of ISOM on M1 and APA. In support, ISOM represents a motor skill-focused training that influences more M1 plasticity than a less-skill focused training [26,27] and that requires high-level attention and cognitive demand, with larger impact on APA than GLOB has [17–19,22].

2. Methods

2.1. Participants

Twenty-four individuals with lateralized CLBP (pain ≥3 months, one side more painful, see Section 2.6), mainly members of Université Laval community having responded to the study advertisement sent by emailing lists, were randomly allocated to two different groups, ISOM or GLOB, using statistical software (see Table 1 for group characteristics). A member of the laboratory not involved in the study prepared a random list where each new participant was allocated to an exercise group. The participants and the therapist could not be blinded to the intervention given the design of the study. However, all data were codified so that the investigator in charge of data analysis remained blinded until completion of the analyses.

The exclusion criteria were non-mechanical LBP (e.g. fracture, malignancy, infection), more than 2 radicular signs, lumbar infiltration in the last 6 months, facet denervation, lumbar surgery, other chronic pain pathology, litigation, specific training of trunk muscles, any major circulatory, respiratory, neurological or cardiac disease, severe orthopaedic troubles (e.g. scoliosis with gibbosity >8 mm), cognitive deficit, or recent/current pregnancy. Exclusion criteria related to TMS testing are reported elsewhere [28] and mainly concerned brain surgery, lesion or injury, any history of seizure or concussion, pacemaker/pump holder, change of medication in the 2 weeks preceding enrollment, medication affecting cortical excitability, metallic implants in skull or jaw. The informed written consent of all participants and the experimental procedures were approved by the local research ethics boards, in accordance with the Declaration of the World Medical Association (www.wma.net).

2.2. Study design

The study was conducted over 3 weeks (Fig. 1) with participants attending 4 sessions (one per week). At the first session (S1), TMS, APA and pain data were collected before the exercise (pre-S1) and each participant learnt and practiced the allocation group exercise (ISOM or GLOB) under the supervision of an expert physical therapist. At sessions 2 and 3, the participant practiced the exercise under supervision and, whenever possible, the difficulty was increased (see Section 2.7). Participants had to perform their exercise twice daily and compliance was reported in an exercise log. At session 4 (S4), the exercise was practiced and APA and pain data were collected after the exercise (post-S4). TMS data were collected before (pre-S4) and after the exercise (post-S4). At all time points (S1, pre- and post-S4), TMS was always tested before APA and, at S4, TMS and APA outcomes were collected before training in the lab and immediately after.

2.3. Surface electromyography (EMG)

Parallel-bar surface EMG sensors were positioned bilaterally to record the activity of superficial MF (MF-S), lower transversus abdominis and internal oblique (TrA/IO), external oblique (EO), semitendinosus (ST) and anterior deltoid (AD) muscles (16-Channel Bagnoli EMG System, Delsys Inc., Boston, MA). After careful skin

Download English Version:

https://daneshyari.com/en/article/8623408

Download Persian Version:

https://daneshyari.com/article/8623408

Daneshyari.com