Journal of Electromyography and Kinesiology 27 (2016) 87–94

Contents lists available at ScienceDirect

Journal of Electromyography and Kinesiology

journal homepage: www.elsevier.com/locate/jelekin

Influence of chronic low back pain and fear of movement on the activation of the transversely oriented abdominal muscles during forward bending ☆

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

[a] Université Laval, Centre de recherche du CHU de Québec, Clinical Neuroscience and Neurostimulation Laboratory, Quebec City, Qc, Canada
[b] McGill University, Constance-Lethbridge Rehabilitation Center – CRIR, Montreal, Qc, Canada

ARTICLE INFO

Article history:
Received 6 October 2015
Received in revised form 2 February 2016
Accepted 13 February 2016

Keywords:
Abdominal muscles
Trunk movement
Chronic low back pain
Lumbar spine
Motor control
Kinesiophobia

ABSTRACT

Introduction: Chronic low back pain (CLBP) and fear of movement (kinesiophobia) are associated with an overactivation of paravertebral muscles during forward bending. This impairs spine motor control and contributes to pain perpetuation. However, the abdominal muscles activation is engaged too in spine stabilization but its modulation with kinesiophobia remains unknown. Our study tested whether CLBP and kinesiophobia affected the activation pattern of abdominal muscles during trunk flexion/extension. *Methods:* Surface electromyographical recordings of the internal oblique/transversus abdominis (IO/TrA) and external oblique (EO) muscles were analyzed in 12 people with CLBP and 13 pain-free subjects during low-velocity forward bending back and forth from erected posture. Tampa Scale of Kinesiophobia was also administrated. *Results:* IO/TrA activation, but not EO, was modulated across the phases of movement in both groups, i.e. maximal at onset of flexion and end of extension, and minimal at full flexion. In CLBP group only, IO/TrA activation was increased near to full trunk flexion and in correlation with kinesiophobia. *Conclusions:* The phase-dependence of IO/TrA activation during trunk flexion/extension in standing may have a role in spine motor control. The influence of kinesiophobia in CLBP should be further investigated as an important target in CLBP management.

© 2016 Elsevier Ltd. All rights reserved.

1. Introduction

Chronic low back pain (CLBP) alters motor control with changes of temporal and spatial recruitment of trunk muscles during postural tasks and gait (Hodges and Richardson, 1996; Lamoth et al., 2006) and with overactivation often observed for the lumbar paravertebral muscles during limb or trunk movements (Macdonald et al., 2011; van Dieen et al., 2003). The task of low-velocity forward bending, back and forth from standing, has been widely used to evaluate the control of paravertebral muscles in people with CLBP and pain-free subjects. A silence of surface electromyographic (EMG) activity of paravertebral muscles, referred as the flexion–relaxation phenomenon, can be observed in pain-free subjects at the end range of trunk flexion (Floyd and Silver, 1955). However, this silence is absent (persistent activation) in the presence of experimental pain, CLBP and fear avoidance beliefs (Alschuler et al., 2009; Shirado et al., 1995; Watson et al., 1997a, 1997b; Zedka et al., 1999). This overactivation may reflect the influence of pain and fear on the motor control of trunk muscles and is often interpreted as an attempt to reduce the loading or the stress on the passive paravertebral structures following an acute injury or flare-up (Panjabi, 1992). In pain-free subjects, a similar silence was reported for the EMG activity of abdominal muscles with transversely-oriented fibers (namely the internal oblique and transversus abdominis – IO/TrA (Urquhart et al., 2005a)) but during slump sitting task (Claus et al., 2009; Dankaerts et al., 2006). Given the importance of IO/TrA in the control of the lumbosacral spine during trunk movement (Bergmark, 1989) and compression and stabilization of the sacro-iliac joint (SIJ) (Richardson et al., 2002; Snijders et al., 1995, 1998), it should be important to elucidate also how IO/TrA behaves during a forward bending task and whether CLBP and/or fear of movement alters this motor control. This knowledge may impact the clinical management of CLBP. Indeed, overactivation of both paravertebral and abdominal

☆ The protocol for this study was approved by the Research Ethics Committees of Université Laval and of the Centre de recherche du CHU de Québec.

* Corresponding author at: Centre de recherche du CHU de Québec, Neuroscience Division, RC-9800, 2705 Blvd. Laurier, Quebec City G1V 4G2, Canada. Tel.: +1 418 5254444x47648; fax: +1 418 654 2753.

E-mail addresses: hugo.masse-alarie.1@ulaval.ca (H. Massé-Alarie), louis-david.beaulieu.1@ulaval.ca (L.-D. Beaulieu), richard.preuss@mcgill.ca (R. Preuss), cyril.schneider@rea.ulaval.ca (C. Schneider).

http://dx.doi.org/10.1016/j.jelekin.2016.02.004
1050-6411/© 2016 Elsevier Ltd. All rights reserved.

muscles during forward bending in chronic pain may repetitively overload the passive spine structures and thus contribute to pain persistence (Hodges, 2013). It is already reported for example that the activation of IO and TrA is closely related (and to a lesser extent for IO) to an increase of intra-abdominal pressure (Cresswell et al., 1992; Cresswell and Thorstensson, 1994) that may increase spine loading.

The objective of this study was thus twofold: (1) to document in pain-free subjects the modulation of abdominal muscles activation during low-velocity forward bending (spine flexion) back and forth from standing (spine extension); (2) to test the differences of activation in people with CLBP and the influence of kinesiophobia (i.e. fear of movement). It was hypothesized that a flexion–relaxation phenomenon would be observed in pain-free subjects (silence at full flexion), given the EMG silence of IO/TrA already reported during slump sitting (Claus et al., 2009; Dankaerts et al., 2006), and IO/TrA overactivation in CLBP (at full flexion) in relation to kinesiophobia.

2. Materials and methods

2.1. Participants

Twelve individuals with lateralized CLBP (one side more painful; pain $\geqslant$3 months) and 13 pain-free healthy controls (CTL, no history of LBP in the last year) were recruited. A visual analogue scale (VAS) and a body scheme (Price et al., 1983) were used in CLBP to quote the level of spontaneous pain in sitting and to determine the more and less painful sides in each participant with CLBP. Pain-free participants' selection required no LBP history in the previous year. The exclusion criteria were similar to a previous study (Masse-Alarie et al., 2013) and mainly concern non-mechanical LBP, lumbar surgery, major cardiorespiratory, neurological diseases or recent/current pregnancy. All participants provided informed written consent and the protocol was approved by the local research ethics boards.

2.2. Trunk movement task

Participants began in quiet standing (QS, Fig. 1A), with feet at hip width. On an auditory signal, participants bent forward (slow and controlled flexion, Fig. 1B) to reach maximal trunk flexion, with minimal knee flexion, and maintained the position (Fig. 1C). Participants then returned to the upright posture on a second auditory signal (Fig. 1D). Following practice trials, the sequence was repeated 5 times, each step of the movement lasting 3 s.

2.3. Surface electromyography (EMG)

Surface EMG recordings were acquired bilaterally for IO/TrA (lower part, transverse fibres – 2 cm medial and inferior to the anterio-superior iliac spine), external oblique (EO – above the IO/TrA electrode, in alignment with umbilicus) and superficial multifidus (MF-S – in alignment with an axis joining the caudal tip of the posterior superior iliac spine and the interspace between L1 and L2 at the level of L5 spinous process) using a Bagnoli parallel-bar surface EMG system (16-Channel Bagnoli EMG System, Delsys Inc., Boston, MA). In the present study, IO/TrA terminology ought to include the inferior and middle parts of the transversely oriented abdominal muscles given their similar attachments (lateral raphe and iliac crest (Barker et al., 2004)) and similar function during postural adjustment (Urquhart et al., 2005b), trunk rotation (Urquhart and Hodges, 2005) and control of intra-abdominal pressure (Cresswell et al., 1992). EO activity was recorded to validate the specificity of IO/TrA activation during the task. MF-S was recorded as a time marker of the trunk movement: given that trunk re-extension (from full flexion to quiet standing) is driven by hip extension (hamstrings and ES activation) then by spine extension (paravertebral muscles activation) (McClure et al., 1997), the timing of the lumbopelvic motion was measured by the primum movens onset, i.e. MF-S onset that drives spine extension, rather than by an accelerometer positioned on the trunk movement and enable to differentiate between hip and lumbopelvic movements. SENIAM recommendations were followed for skin preparation and electrodes placement (Hermens et al., 2000) with a ground electrode on the iliac crest. The signals were low-pass filtered (500 Hz) and amplified (1000×) before digitization (2000 Hz), and stored for online display and offline analysis. The digitized signals were filtered (digital bandpass-filter, 10–450 Hz, zero-phase lag Finite Impulse Response filter) and full-wave rectified prior to analysis (PowerLab, LabChart-ADInstruments, CO).

2.4. Questionnaires

Participants with CLBP completed the Oswestry disability index (ODI) (Fairbank et al., 1980), as a measure of the functional disability, and the Tampa Scale of Kinesiophobia (TSK) (Vlaeyen et al., 1995) as a measure of the fear of movement/(re)injury. All participants completed the Global Physical Activity Questionnaire (GPAQ) in order to rate the level of physical activity.

2.5. Data reduction and statistical analysis

IO/TrA and EO EMG activity were normalized to the mean activation levels during a crook lying double leg raise task performed

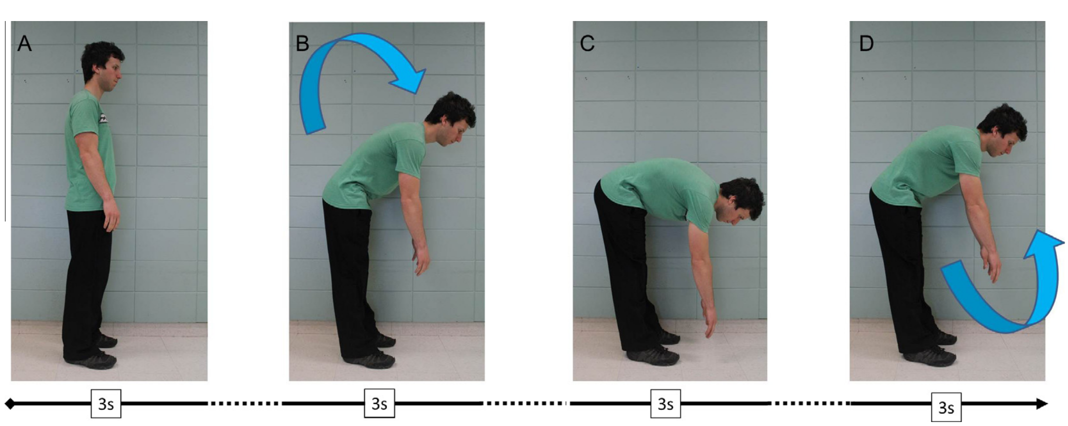

Fig. 1. Functional task. (A) Quiet standing (erected posture). (B) Flexion of the trunk lasting 3 s. (C) Maximal flexion of the trunk with minimal knee flexion maintained during 3 s. (D) Extension of the trunk lasting 3 s from the maximal flexion position back to quiet standing.

Download English Version:

https://daneshyari.com/en/article/4064424

Download Persian Version:

https://daneshyari.com/article/4064424

Daneshyari.com