Manual Therapy 20 (2015) 63–67

Contents lists available at ScienceDirect

Manual Therapy

journal homepage: www.elsevier.com/math

Original article

Are tactile acuity and clinical symptoms related to differences in perceived body image in patients with chronic nonspecific lower back pain?

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ARTICLE INFO

Article history:
Received 15 March 2014
Received in revised form
25 June 2014
Accepted 27 June 2014

Keywords:
Low back pain
Tactile acuity
Body image
Cortical reorganization

ABSTRACT

Clinically, perceived image of the lower back and the two-point discrimination (TPD) test are used as markers for evaluating alterations of cortical reorganization. The purpose of the present study was to examine whether TPD and selected clinical findings are different in subgroups of individuals with chronic nonspecific lower back pain (CNLBP) based on body image drawings. Forty-two patients with CNLBP and seventeen healthy individuals were recruited. Perceived body image, TPD and clinical profiles was measured. Of the patients with CNLBP, 42.8% had a normal perceived body image, 28.5% an expanded image, and 28.5% a shrunken image. The TPD distance threshold was significantly larger for the expanded subgroup (13.3 ± 6.8 mm) compared with the control (5.5 ± 3.8 mm; Difference, 7.8; 95%CI, 1.83 to 13.66; $p < 0.05$) and normal subgroups (4.5 ± 5.5 mm; Difference, 8.8; 95%CI, 2.90 to 14.59; $p < 0.05$). No significant differences in pain intensity, duration of pain, Roland Morris Disability Questionnaire (RDQ), and Pain Catastrophizing Scale (PCS) scores were found between three body image subgroups. Our results suggest that TPD is increased in patients who report an expanded perceived image of the lower back compared with healthy individuals and patients who report a normal image. The effectiveness of new rehabilitation techniques may be evaluated by assessing perceived image of the lower back and TPD values for patients with CNLBP before and after treatment.

1. Introduction

Extensive evidence shows that chronic back pain is associated with cortical dysfunction, including distorted representation of the back in the somatosensory cortex and structural and functional changes in the prefrontal cortex (Flor et al., 1997; Apkarian et al., 2005; Tsao et al., 2008). Several studies have demonstrated that changes in the somatosensory cortex with chronic pain, including complex regional pain syndromes (CRPS) and phantom pain, correlate with the pain intensity (Flor et al., 1995; Pleger et al., 2004, 2006).

In contrast, in patients with CRPS who received treatment, including physical therapy and nonsteroidal anti-inflammatory drugs, significant pain alleviation was reported and cortical reorganization of the somatosensory cortex was largely reversed after approximately 1 year (Maihöfner et al., 2004). Wand et al. (2011) reported that a sensorimotor retraining approach decreased pain intensity and disability in patients with chronic nonspecific lower back pain (CNLBP). A previous study found that pain was decreased and somatosensory cortex was activated using multichannel electroencephalography in a patient with severe lower back pain by performing a tactile discrimination training in which the patient discriminated the hardness of a sponge (Nishigami et al., 2012). These studies indicate that reversal of cortical reorganization in the somatosensory cortex is associated with a decrease in pathological pain in patients experiencing chronic pain.

Clinically, perceived body image and the two-point discrimination (TPD) test are used as markers for evaluating alterations of cortical reorganization (Haggard et al., 2003; Pleger et al., 2003; Ehrsson et al., 2005; Moseley, 2005; Flor et al., 2006; Lotze and

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http://dx.doi.org/10.1016/j.math.2014.06.010
1356-689X/

Moseley, 2007; Lewis and Schweinhardt, 2012). Body image is defined as how an individual perceives the physical appearance of their own body (Lotze and Moseley, 2007). Recent brain imaging studies have shown that perceived image is associated with the somatosensory cortex and posterior parietal cortex (Graziano and Botvinick, 2002; Haggard et al., 2003; Ehrsson et al., 2005). Several studies reported that distorted body image occurs in patients with CRPS (Förderreuther et al., 2004; Moseley, 2005; Lewis and Schweinhardt, 2012) and phantom limb pain (Flor et al., 2006), which may also be due to alteration of cortical reorganization in the somatosensory cortex. Pleger et al. (2006) reported that impaired tactile discrimination appears to parallel alteration of cortical reorganization in the somatosensory cortex and pain intensity in patients with CRPS.

Recently, it has been clarified that perceived image and TPD scores are related in CRPS (Peltz et al., 2011; Lewis and Schweinhardt, 2012). The magnitude of body image distortion correlates with disease duration and decreased tactile acuity in patients with CRPS (Peltz et al., 2011). In patients with lower back pain, tactile acuity was more decreased compared to healthy volunteers (Wand et al., 2010). Moseley (2008) reported that missing body image and decreased tactile acuity coincide with the distribution of chronic lower back pain. However, it is quite likely that there are patients with an expanded image as well as a missing image, because patients with an expanded or a missing image in CRPS have been reported (Lewis et al., 2007; Peltz et al., 2011). It is unclear whether lower back pain and tactile acuity are related to differences in perceived image of the lower back. Moreover, Catley et al. (2013) recently reported that large variability was observed in TPD assessment of the back. The study indicates that it is difficult to compare changes in raw tactile acuity values for individual patients, and in fact, calls into question the reliability of some studies using raw tactile acuity values. More recently, it was shown that the mean difference in TPD values between sides of the lumbar spine was very small in healthy volunteers, making this value a useful reference for comparing patients with lower back pain and healthy volunteers (Wand et al., in press). A difference in the perceived image of the lower back may be a useful marker of reorganization in the somatosensory cortex, particularly when investigating the relationship between perceived image of the lower back and the differences in the mean TPD from different sides. The purpose of the present study was to examine whether TPD and selected clinical findings are different in subgroups of individuals with CNLBP based on perceived image drawings.

2. Methods

2.1. Participants

Forty-two patients who had CNLBP for more than 6 months and were between 30 and 80 years of age were recruited from an orthopedic clinic. Patients were not included in the study if they had signs or symptoms of nerve root pain, evidence of specific spinal pathology (e.g., malignancy, fracture, infection, spinal canal stenosis, or inflammatory joint or bone disease), a body mass index >30, neurological or psychiatric disorders, or had undergone spinal surgery. Seventeen healthy individuals with no history of chronic lower back pain and no diagnosed diseases and who matched the age and gender of the enrolled patients were recruited as controls. Ethical approval was obtained from the institutional ethics committee of Konan Woman's University. Written informed consent was obtained from all subjects prior to the study. The study was conducted in compliance with the Declaration of Helsinki.

2.2. Perceived image of the low back

The perceived image of the low back was measured according to the methods described by Moseley (2008). The patients were instructed to sit in a chair and were given the following instructions: “Concentrate on your back. Add to this drawing by following the outline of your own back as you track it in your mind. Concentrate on where you feel your back to be. Also draw in the vertebra that you can feel. Do this without touching your back. Do not draw any part you cannot sense. Do not draw what you think your back looks like- draw what it feels like.” The author determined the subgroups from both the perceived body line drawn by patient and their mental imaging as follows: The author checked whether the perceived body line drawn by the patient shifted from the line that connected the top and bottom on each side. If the drawn body line was anatomically consistent with the actual size and shape, the patient was classified as normal. If the drawn body line was not anatomically consistent with the actual size and shape, and if the drawn body line shifted to the outside, the patient was classified as expanded, and if the drawn body line shifted to the inside, the patient was classified as shrunken. Moreover, while looking at the picture drawn by the patient, patients were asked “In fact, do you feel this perceived image is normal, expanded, or shrunken?” When the drawn line was consistent with the mental image, the patient was classified as normal, expanded, or shrunken, as appropriate (Fig. 1). If the drawn body line was not anatomically consistent with the actual size and shape, however, and if the patient answered normal by their mental image, the patients were assigned to the normal group.

2.3. TPD

The TPD threshold was measured according to methods described by Moberg (1990) and Wand et al. (in press). TPD was assessed bilaterally in the low back. A plastic caliper ruler with a precision of 1 mm was applied to the back until the very first blanching of the skin. The calipers were aligned perpendicular with the spine so that the transverse process of the most severe pain level and of the same level on the opposite side in patients with CNLBP and of L3 level in healthy individuals was centered between the two tips of the caliper (Luomajoki and Moseley, 2011). Calipers were applied initially with 0 mm between the two tips, and the distance between the tips was increased by 5-mm increments until the subject was able to perceive two points instead of one. Subjects were instructed to say “one” when they perceived one point and “two” when they perceived two. Calipers were applied to the vertebrae in a descending order (between the two tips of the caliper was decrease in 5 mm increments from 10 cm) and then again in an ascending order (between the two tips of the caliper was increase in 5 mm increments from 1 cm), and values in one descending run and one ascending run were averaged (Luomajoki and Moseley, 2011). One side-to-side difference value was calculated by subtracting the lower TPD value from the higher value in each healthy control subject, according to methods described by Wand et al. (in press), and by subtracting the TPD value in the lower pain side from the TPD in the higher pain side for each patient with CNLBP. Wand et al. (in press) reported that differences of greater than 13 mm when assessed horizontally equate to 95% confidence that a difference truly exists. The number of subjects with a TPD difference greater than 13 mm was calculated for each group.

2.4. Clinical profiles

Clinical profiles include pain intensity, pain duration, Roland Morris Disability Questionnaire (RDQ) and Pain Catastrophizing