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Technical and measurement report

The point-to-point test: A new diagnostic tool for measuring lumbar tactile acuity? Inter and intra-examiner reliability study of pain-free subjects

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ABSTRACT

A two-point discrimination test (TPD) is commonly used to investigate lumbar tactile acuity. However, low inter-examiner reliability and difficulties in execution significantly limit its application. Therefore the aim of this study was to compare the inter- and intra-examiner reliability of a new approach, the point-to-point test (PTP), with the TPD. Twenty-one pain-free subjects attended the inter-examiner stage of the study. Eighteen of them were further recruited into an intra-examiner (reproducibility and repeatability) reliability study. PTP was performed on the three points plotted at the L3 spinal level. Point '0' overlapped with the L3 spinous process, from which points '1' and '2' were horizontally separated by 5 and 10 cm, respectively. Participants manually indicated a point previously touched by the examiner, while the distance (error) was measured. Reliability was determined with the intraclass correlation coefficient ($ICC_{2,3}$). The results revealed good and moderate inter- and intra-examiner reliability at point '1' ($ICC_{2,3}$ = 0.68–0.84) and good reliability at point '2' ($ICC_{2,3}$ = 0.84–0.86). At point '0', reliability was moderate to poor ($ICC_{2,3}$ = 0.13–0.63). TPD was characterised by a poor to moderate level of inter- ($ICC_{2,1}$ = 0.51; $ICC_{2,3}$ = 0.56) and intra-examiner reliability ($ICC_{(2,1)}$ = 0.50; $ICC_{2,3}$ = 0.74). Our findings suggest that PTP is more reliable than TPD at two investigated points at the L3 spinal level. However, further research on PTP validity data is strongly warranted.

1. Introduction

Body perception and tactile acuity are disrupted in many chronic pain states, including chronic non-specific low back pain (CNLBP). Extensive evidence suggests that CNLBP is linked to alterations within the somatosensory cortex (S1) (Flor et al., 1997; Schmidt-Wilcke et al., 2006). These alterations might be reflected in clinical examinations, including body schema drawings (Moseley, 2008; Nishigami et al., 2015; Tsay et al., 2015), and two-point discrimination (TPD) tests (Lotze and Moseley, 2007; Wand et al., 2013b), which have been recommended as a measure of S1 profile/reorganisation (Lotze and Moseley, 2007). Indeed, an expanded TPD threshold has been demonstrated as a feature of CNLBP (Wand et al., 2010; Luomajoki and Moseley, 2011; Nishigami et al., 2015), while it has been shown that higher intensity of pain is reported if more prominent reorganisation of S1 is present (Lloyd et al., 2008).

From a clinical point of view, the existence of a link between pain, TPD and S1 profile is important for at least two reasons. First, it can explain why pain might persist despite the lack of a relation between recognisable pathology and its intensity, indicating that central mechanisms may play a crucial role in CNLBP (Chou et al., 2011). Second, pain-associated S1 alterations comprise potential targets for therapeutic interventions (Moseley and Flor, 2012); for example, sensory discrimination training (Wand et al., 2013a). It

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should be noted, however, that clear recognition of patient subgroups with sensory-like abnormalities is still a challenge in both clinical and laboratory settings. This challenge is probably owed to the lack of reliable diagnostic tools and unbiased measurement techniques.

Although TPD has been reported to have good intra-examiner reliability (Wand et al., 2014), its inter-examiner reliability is only moderate (Catley et al., 2013; Wand et al., 2014). Furthermore, there are several factors that may potentially bias TPD results (Moberg, 1990; Lundborg and Rosén, 2004; Catley et al., 2013; Tong et al., 2013). For example, participants have to judge their perception (one vs. two points), which may be affected by the application of forces during stimuli. In addition, 'assessor bias' can also occur, as the examiner often needs to make a decision as to when the TPD threshold has been identified. Another technical downside is that TPD execution requires synchronous touching by calliper tips, which may be difficult for examiners. Within-subject factors such as a learning effect observed as improvement in TPD scores along with subsequent repetitions should not be neglected either. Moseley and Wiech (2009) demonstrated that 30 min of such tactile training may be sufficient to evoke significant changes in TPD results.

These limitations may reduce the reliability of TPD (Catley et al., 2013), and therefore other diagnostic tests aimed at measuring lumbar tactile acuity are being sought in order to provide reliable and accurate data on the S1 profile. The point location test developed by Weinstein (1968) and originally intended for the hand area (Bell-Krotoski et al., 1993) seems to be an alternative tool in this context. This largely abandoned test should be reconsidered in terms of its clinical utility in the light of TPD limitations. Therefore, the present study had two aims: (1) to introduce the point-to-point test (PTP), which is a modern modification of the test described by Weinstein (1968) as a novel tool for measuring lumbar tactile acuity, and (2) to provide inter- and intra-reliability data in comparison with TPD.

2. Material and methods

This study was performed within a laboratory setting at the corresponding author's university. Additionally, bioethical approval was provided (No. 16/2007) by the same institution. Both participants and examiners were naïve to the purpose of the study.

2.1. Participants

Twenty-four healthy volunteers were enrolled in this study. This was a convenience sample (age 25 ± 2.91 years, height 177.26 ± 10.71 cm, weight 72.29 ± 15.01 kg) recruited via oral announcement. Exclusion criteria were similar to those described by Catley et al. (2013): current pain (n = 2), back pain during the last three months (n = 1), neurological disease (or overt neurological signs), inability to detect light touch, and age > 35 or <18 years. All participants gave written informed consent.

Required sample size was determined a priori according to Walter et al.'s (1998) calculations, indicating that at least 18 subjects should be examined for the purpose of intra-examiner and 14 subjects for inter-examiner reliability (80% power). In fact inter-examiner reliability was calculated on data from 21 participants and intra-examiner from 18, because of the unavailability of three of them.

The examiners included one medical and one PhD student, and both attended a brief training session prior to the study. The training lasted 30 min (Catley et al., 2013) after which a physiotherapist experienced in TPD examination answered the examiner's questions.

2.2. Procedure

To measure both TPD and PTP, mechanical sliding callipers (Powerfix, digital calliper: Z22855) with a precision of 0.01 mm were used. Participants were positioned prone with the low back exposed (Wand et al., 2014; Catley et al., 2014b); examiners palpated the L3 spinous process from where a horizontal axis was drawn on the chosen side of the spine. Then, three points were plotted on the axis 5 cm apart. The reference 'zero' point overlapped the L3 spinous process (Fig. 1). To perform PTP, participants were asked to maintain a pen perpendicularly to the surface around the level of 12th thoracic vertebra. Then, the examiner lightly and randomly touched one of the three points (the '0' point or another two located on the same side as the participant's hand holding a pen). The participants were instructed as follows: '*Use your pen to touch the point that I will touch as accurately as you can. Do not slide, but move the pen*'. For each point, three trials were repeated. To analyse PTP, the distance between pre-marked points and points indicated by the participants was measured with callipers. The order of the side testing, test procedure and point touching, as well as the order of the examiners, was randomised.

TPD was tested at one location, i.e. along the horizontal axis running through three points (Fig. 1). To measure TPD, a modification of the testing protocol described by Luomajoki and Moseley (2011) was used. Callipers were delicately applied to

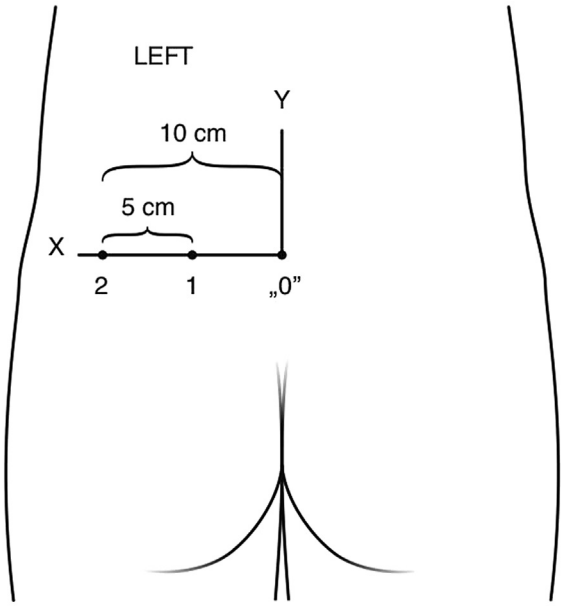

Fig. 1. Topography of the measurements. Two-point discrimination (TPD) and point-to-point (PTP) test were examined on randomly assigned side of the spine. Horizontal 'x' axis refers to the L3 spinal level, while vertical 'y' axis refers to the midline plane. TPD was assessed on the 'x' axis starting from point '1'. The PTP test was assessed in three randomly ordered points: '0', '1' and '2'.