

Inter-Rater Reliability of Grid Localization Test of Tactile Spatial Localization for the Low Back

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Received: May 14, 2021; Published: May 27, 2021

Abstract

Background: Tactile acuity is often altered in various persistent pain conditions. There are limitations to some of the current tactile acuity measures available for clinical use.

Objectives: Develop and test reliability of a novel grid localization test (GLT) for tactile spatial localization. Establish inter-rater reliability along with minimal detectable difference for GLT and compare to more established tactile acuity testing of two-point discrimination.

Design: Cross-sectional, observational study of inter-rater reliability.

Methods: Two different testers measured tactile spatial localization testing for the low back utilizing newly established GLT procedure on healthy individuals. Participants during GLT had to identify which area of the back was touched within a defined grid based on 10 touches. An accuracy score was determined based on correct/incorrect response.

Results: Thirty-six participants (N = 36, female = 27) with an average age of 23.3 (range 22 - 30) were studied. ICC (2, k) for the grid localization test between testers was 0.74. The average score was 78% correct with a minimal detectable difference of 29%. There was no correlation between GLT results and two-point discrimination.

Conclusion: The novel GLT demonstrated fair inter-rater reliability and may be evaluating a different component of tactile acuity compared to two-point discrimination testing.

Keywords: Tactile Acuity; Tactile Spatial Localization Testing; Reliability

Introduction

Tactile acuity is a key component of a normal functioning somatosensory system. Tactile acuity allows an individual to discern the sense of touch or stimuli and localize the site of the sensory stimuli. Evidence has demonstrated that individuals with persistent pain often have impaired tactile acuity abilities [1,2]. This impairment in tactile acuity may be due to a shift in the individual's central nervous system structure and function [3-6]. These cortical changes alter the brain representation of the body for these individuals and could be a potential source for symptoms [7,8].

Providing a quality clinical measurement of altered tactile acuity is fundamental to the assessment and measurement of progress with a rehabilitation program for individuals with impairments in this area. Currently, there are various methods of measuring and training tactile acuity in clinical practice and the literature. Some of the methods used are: two-point discrimination (TPD) [9,10], tactile spatial localization [11,12], grating orientation task [13], graphesthesia [14-16] and stereognosis [17]. TPD is the most commonly used measurement in clinical practice and research for tactile acuity for chronic pain [1,2].

While TPD is the most common, there have been concerns raised about its clinical utility due to wide variance in normative data, less than ideal reliability, challenges with testing protocol for examiners and subjects [18-21]. Because of these challenges and recognizing that alterations in body representation through tactile acuity testing may be evaluated in more ways than just TPD, newer tests are being developed and trialed [11,18,19]. One of these methods that has shown benefit from a training and rehabilitative standpoint but has not

been developed extensively from a standardized testing level is tactile spatial localization testing. Wand and colleagues [12], in a preliminary investigation utilized large body regions within the tactile spatial localization testing; whereas, Harvie, *et al.* [11] utilized the Imprint Tactile Training Device and much smaller grid regions and the use of vibration instead of tactile touch.

Purpose of the Study

The purpose of this research is to further explore and develop a testing procedure for tactile spatial localization testing for the low back. The aim was to develop interrater reliability and minimal detectable difference with grid localization testing (GLT) protocol for tactile spatial localization testing on a healthy population. A secondary aim will be to investigate the correlation of GLT performance with traditional TPD testing.

Materials and Methods

Participants

A convenience sample of healthy adults were recruited from a University campus via posters, email, and word of mouth. Participants were excluded if they had recent low back surgery or current active conditions with associated reduced tactile acuity, pain, or neurological diseases. Also excluded were individuals with cognitive impairments, wounds, neuropathy, or pregnancy. Inclusion criteria consisted of English-speaking abilities and over the age of 18. Participants signed informed consent prior to initiating any testing and the study protocol was approved by the University IRB (IRB-19-53).

Instruments

A grid localization tool (Figure 1) was 3D printed using a grid with 3 rows with 4 columns for a total of 12 tactile sites, which was similar to the Imprint Tactile Training Device used by Harvie [11]. The size of the squares on the grid measure 50 mm, which is similar to normative data for TPD ability in the low back [22]. A Carolina 2-Point Discriminator (model #696417, Carolina Biological) was used for TPD testing and the single prong on the device was used for tactile touch in the middle of a square on the grid localization tool.

Procedure

After informed consent and completing demographic data intake, participants TPD was assessed using established protocol [22]. Participants were prone on a standard therapy treatment table with the skin exposed while the researcher completed TPD testing horizontally at the L3 level with 3 ascending and descending measurements on the right and left with the average score recorded. After completion of TPD testing, a 5-minute break was given to the participant prior to a second and third research examiner commenced performing GLT. During GLT, the grid localization tool was placed with the bottom of the grid in alignment with the posterior superior iliac spine of the participant and the center of the grid running up the spinous processes (Figure 1). The tester then provided a baseline to the grid numbering system with touching the center of the grid localization tool for each corresponding square in sequential order (Figure 1). Touches were applied in the same fashion as TPD testing with enough pressure to blanch the skin. Participants were provided a pictorial image of grid localization tool on the back with the numbering sequence to assist with recall during testing. The tester began the test by providing 5 trial tactile touches in a random order sequence to ensure each participant understood the directions. After the trial touches, 10 test touches were provided in random order and number of correct responses were recorded. Only one tactile touch into a square was provided, if participant reported they were not sure which square was touched it was recorded as a missed square and the next random site was tested. A minimum of 5 seconds was allotted between each touch point into a square location. After the 10-touch test trial, a 5-minute break was provided to the participant before a second researcher repeated the procedure for GLT. Five different random trial and test orders were developed prior to testing and these were randomized between researchers prior to commencement of study along with random order of which tester went first.

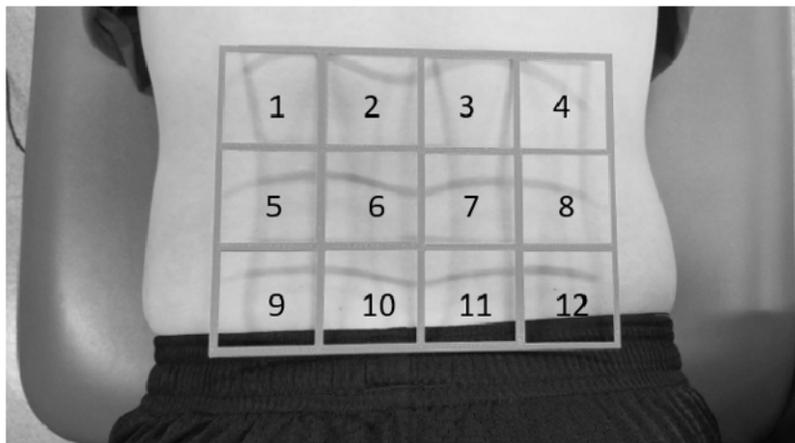


Figure 1: Grid localization tool placement on low back of participant with square numbering sequence.

Statistical analysis

Data was analyzed using the IBM SPSS Statistic for Windows, Version 25 (IBM Corp., Armonk, N.Y., USA). Means and frequency counts were recorded for the demographics data. Intraclass correlation coefficient (ICC) values utilizing average measure for two-way random effects model were calculated to determine inter-rater reliability between the grid localization testers. Bland-Altman plots were used for determining variability, agreement, and bias with mean difference and limits of agreement at 1.96 standard deviations above and below mean reference lines. ICC interpretations were assessed by guidelines of excellent (> 0.90), good (0.75 - 0.90), moderate (0.50 - 0.74), and poor or no relation (< 0.50) [23]. A 95% confidence interval was used to calculate standard error of measurement ($SEM = SD_{pooled} \sqrt{1-ICC}$) and minimal detectable difference ($MDD = 1.96 * SEM * \sqrt{2}$). One-way ANOVA determined if there were differences between sequence order testing options between participants. A Pearson Correlation Coefficient was used to compare the accuracy score from both researchers of the subject’s GLT performance with the average of their recorded TPD scores. Strength of correlation coefficient was valued at good to excellent (above 0.75), moderate to good (0.50 to 0.75), fair (0.25 to 0.50) and little or no relationship (less than 0.25) [23]. A p-value of < 0.05 was set for significance level.

Results

Thirty-six healthy individuals consented and participated in the study with demographic characteristics provided in table 1. There were no dropouts during the study duration.

Characteristics	Mean (SD)	Minimum	Maximum
Gender (Female)	27		
Age (Years)	23.33 (1.43)	22	30
Height (Meters)	1.72 (0.09)	1.549	1.91
Weight (Kilograms)	72.58 (18.90)	49.9	142.88
Body Mass Index (BMI)	24.29 (4.22)	17.23	39.37

Table 1: Demographics (n = 36).

Grid localization percent correct normative values for the participants along with TPD norms for right and left side are presented in table 2.

	Mean (SD)	Minimum	Max
Grid Localization (tester 1)	77.8 (18.8)	20	100
Grid Localization (tester 2)	78.9 (22.4)	20	100
TPD on right	39.8 (11.6)	14.2	61.8
TPD on left	42.6 (13.7)	19.2	68.3

Table 2: Grid Localization and Two-point discrimination norms for participants (n = 36).

TPD = Two-Point Discrimination.

ICC values for interrater reliability for GLT were moderate (ICC = 0.74, 95% CI .48 to .87, p < .001). Bland-Altman plots provided in figure 2. The SEM equals 10.6% with the MDD found to be 29% for the GLT. No correlations were found between body anthropometrics and GLT scores. In addition, no differences were found when comparing the random sequence order of testing results between participants.

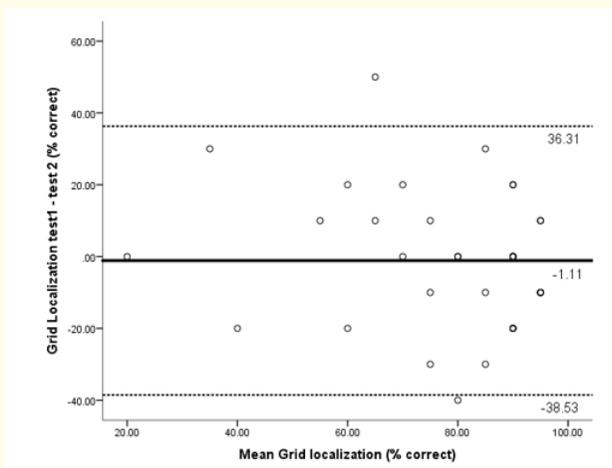


Figure 2: Inter-rater reliability Bland-Altman plots for grid localization test.

Pearson correlation for TPD values and GLT percent correct for tester 1 and tester 2 demonstrated no correlation, $r = -0.242$, $p = 0.156$ and $r = -0.099$, $p = 0.566$, respectively.

Discussion

Wand, Keeves, Bourgoin, George, Smith, O’Connell, Moseley [12] utilized tactile spatial localization stimulation with healthy adults and those with chronic low back pain and found that 76% of the individuals with low back pain made at least 1 error with the 5 tactile trial points and only 25% of the controls without back pain made at least 1 error. Demonstrating that tactile spatial localization was altered between healthy controls and those with back pain. Wand, Keeves, Bourgoin, George, Smith, O’Connell, Moseley [12] however did not calculate reliability with their testing procedure. The current procedural methodology attempted to measure inter-rater reliability for evaluating GLT for the low back. The current method demonstrated moderate reliability. This is promising as it was a relatively quick measurement taking 2 minutes on average to complete the testing. The ICC values in this study were slightly better than the 0.60 value

reported by Harvie, *et al* [11]. In their measurement tool, they utilized vibration sensation and not tactile sensation, which could account for some of the differences as their accuracy rate was only 55% compared to the higher 78% and 79% found in this study. In addition, the size of the grid, depending on the body region, could also play a role in accuracy rates. Previous testing protocols did not report the grid size. The lack of correlation between the GLT and TPD test was not surprising as other tactile acuity tests have also found limited to no correlation between them [18,20]. This may be in part to the different testing methods that are testing different brain functions for different perceptual types of tactile acuity.

The current study does have limitations due to being a novel testing procedure. The participant sample size was small and from a young and healthy cohort, so further testing will need to be done with a broader demographic range of participants both with and without back pain to further inform on what normative values might be. Also, further studies should explore the effect of the number of test points has on reliability. Adding in additional test points might improve reliability and narrow the SEM. In addition, the size of the grid squares could be explored to see the effect of different size of grid squares has on accuracy of scores. It was promising that this study did not demonstrate significant floor or ceiling effects with the testing procedure, with only a few individuals scoring 100% and no one scored below 20%. Care should be taken in using the GLT for clinical practice and clinical reasoning with patients until further testing and development of the GLT protocol can be expanded upon.

Conclusion

In conclusion, this current study provides a baseline of normative data for the GLT to the low back. It can be used for further exploration and refinement of a GLT procedure that demonstrates moderate reliability to use for measurement of tactile spatial localization as a form of tactile acuity testing for the low back.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

Disclosure of Interest

The authors report no conflict of interest.

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Volume 12 Issue 6 June 2021

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