A new method of measuring touch localisation reveals performance differences between the distal pads of the fingers of healthy controls

Martin Weber¹, Ronan Timircan¹, Francis McGlone², Andrew Marshall³, Obi Onyekwelu¹, Simon Watt⁴, Edwin Jesudason⁵, Vivien Lees⁶,⁷, Ken Valyear¹.

¹ Bangor University, Bangor, UK, ²Liverpool John Moores University, Liverpool, UK, ³University of Liverpool, Liverpool, UK, ⁴Manchester University Foundation Hospitals Trust, Manchester, UK, ⁵Betsi Cadwaladr University Health Board, Bangor, UK, ⁶University of Manchester, Manchester, UK

Contact: mrw19pnz@bangor.ac.uk

Introduction

- Touch localisation—locognosia—is impaired following surgical repairs of the major nerves of the hand, yet our understanding of the nature of these impairments is limited.
- Available methods ignore or lack necessary information about sensitivity and direction.
- Methods—transverse, longitudinal—error.
- Available methods also tend to conflate measures of absolute and directional error.
- Responses are made to an incorrect digit.

Aim

Develop a new test of locognosia that enables reliable measurement of absolute and directional error, and misreferrals, in patients with hand-nervous injuries.

Participants

- Controls 'Group 1'—proof-of-concept
  - N = 16; Age: mean = 29y, range: 20 – 41y; Gender: 11 female; Handedness: 11 right-handed.
- Controls 'Group 2'—replication test & comparison against nerve repair patients
  - N = 25; Age: mean = 34y, range: 19 – 52y; Gender: 20 female; Handedness: 24 right-handed.
- Patients
  - N = 14; Repair: median = 5, ulnar = 4, both = 5; Time since repair: mean = 34 mo., range = 8 – 82 mo.
  - Patients: 13 right-handed.

Rosen Sensory Score

- Standardised test of hand function after median/ulnar nerve repairs: Sollerman hand function subtests 4, 8, and 10.
- Patients: Marsh Method: median = 5, ulnar = 4, both = 5; Time since repair: mean = 34 mo., range = 8 – 82 mo.
  - Patients: 13 right-handed.

Group-level Results

- Controls
- Patients

Individual-level Results

- Controls
- Patients

Discussion

- Our new method enables detailed characterisation of locognosia performance with high sensitivity and reliability, and is practical for use as a clinical research tool.
- Healthy controls show performance differences between the distal pads of the fingers. The index finger shows smaller absolute localisation error compared to the long and ring fingers, and this was observed across two independent groups.
- Patients show increased absolute localisation error within the injured nerve territory, and these effects correlate significantly with sensory Rosen scores. And, some individual patients show a high number and/or unique pattern of misreferrals.
- Patient results may help to understand changes in peripheral and/or central organisation after hand-nerve injury and repair.

Locognosia: Digital-Photograph Method

- The hand is blocked from participants view and points are marked with a UV pen.
- Points are made on the distal-pad of each finger, and on the radial side of the distal-pad of the thumb.
- Each point is stimulated using a 6.1 Semmes-Weinstein monofilament, with UV lighting on, and the participant uses a computer mouse to indicate their felt position on a photograph of their hand, taken with UV lighting off.
- The mean absolute and directional error are computed.
- Patients verbalise the felt position of each stimulation, and responses are made to an incorrect digit or to the palmar surface of the hand—are analysed separately.

Locognosia: Marsh Method

- Standardised test of touch localisation after median/ulnar nerve repair, with established validity, reliability, and sensitivity.
- Zones are defined on the hand. Each zone is stimulated using a 6.1 Semmes-Weinstein monofilament while the hand is blocked from view.
- Participants verbalise the felt position of each stimulation, and responses are converted to a score according to whether the correct zone is reported.

Methods

Results

- Comparison with Marsh Method
  - Controls (N = 31)
  - Controls (N = 25)

References