

## INTRODUCTION

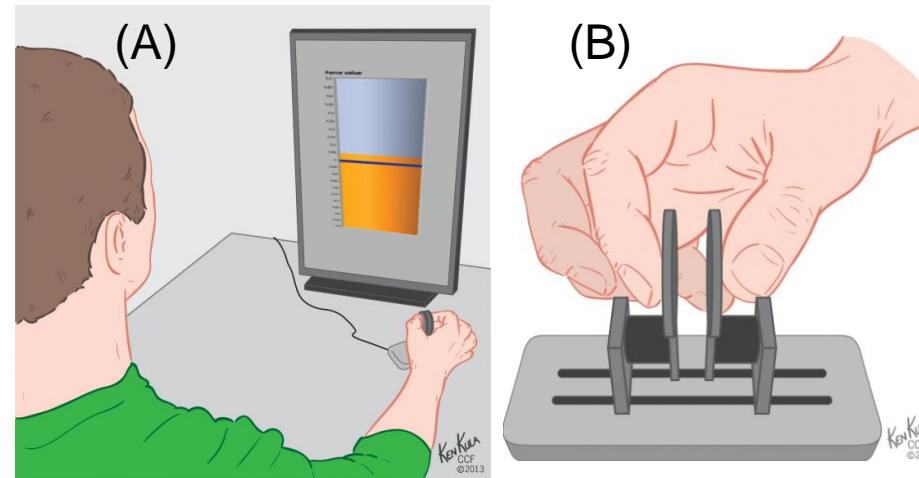
- Carpal tunnel syndrome (CTS) is caused by chronic compression of the median nerve in the carpal tunnel.
- CTS is the most common hand disorder in the general population.
- Patients with CTS experience hand clumsiness and have difficulty with dexterous manipulation of objects.

## OBJECTIVE

- The purpose of this study was to investigate the effects of CTS on force accuracy and stability during a sustained precision pinch.
- We hypothesized that patients with CTS would have decreased force accuracy and increased force variation during precision pinch.

## METHODS

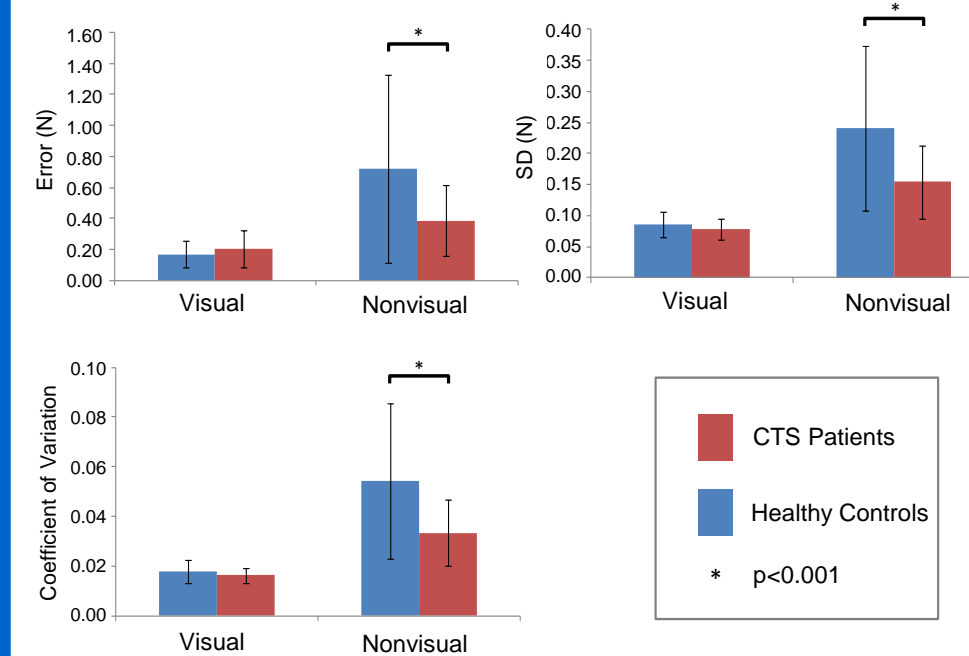
- Seven CTS patients (1 males, 6 females, Age:  $45.7 \pm 8.0$  y) and seven healthy volunteers (7 females, Age:  $41.9 \pm 6.4$  y) participated in this study.
- Subjects were instructed to pinch an instrumented apparatus with the pulps of their thumb and index finger for 60 seconds, applying a stable force output of 5N to match a target line (Figure 1).
- Visual feedback of the real-time pinch force and the target line was provided for the first 30 seconds, but removed for the remaining 30 seconds.
- The force accuracy was quantified as the difference between the real-time force and the target line.
- The force stability was quantified using standard deviation (SD) and coefficient of variation (CV).



**Figure 1.** Experimental setup for the pinch task. (A) A subject interfacing with the pinch apparatus while viewing the monitor for force feedback. The yellow bar shows the real-time grip force and the target line is displayed in the middle of the tank at 5 N. (B) Close-up of the typical pinching posture assumed while the digits are interfacing with the apparatus.

## RESULTS

- With visual feedback, there was no significant difference between the CTS and control groups for the force errors, SDs and CVs ( $p > 0.05$ , Figure 2).
- CTS patients had greater force errors, SDs and CVs than the healthy controls when the visual feedback was removed ( $p < 0.001$ , Figure 2).
- The thumb had lower force errors, SDs and CVs than the index finger for both the visual feedback and no visual feedback conditions ( $p < 0.05$ ).



**Figure 2.** Accuracy and variability of the pinch force applied by the CTS and control groups for the conditions of with and without visual feedback.

## DISCUSSION

- CTS-induced sensorimotor deficits led to reduced accuracy and decreased stability of the pinch force when no visual information was provided to guide the force production.
- Patients with CTS may heavily rely on visual feedback to compensate for the loss of tactile sensation to accurately and stably apply force.
- During precision pinch, the thumb had less force accuracy and stability than the index finger for both the CTS subjects and controls.
- This study provides insight into the sensorimotor deficit caused by CTS and inter-digit force control mechanisms during precision pinch.