The Digital Clock Drawing Test (dCDT) - I: Information Contained Within The "Noise"

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OBJECTIVE

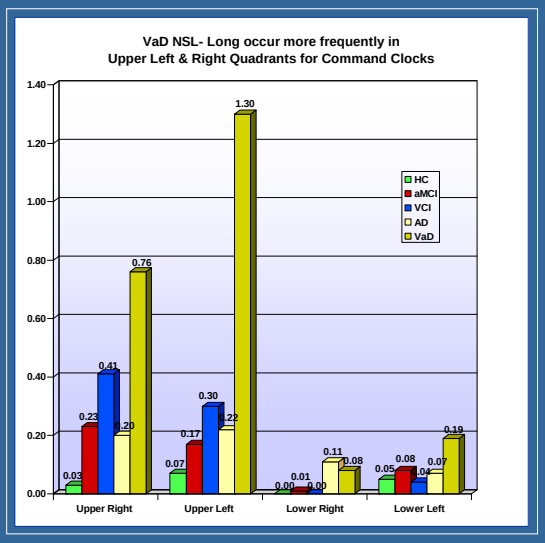
The Digital Clock Drawing Test (dCDT) measures quantitative and process variables of clock drawings captured by a digitizing ballpoint pen. The spatial resolution of the pen enables our program to capture strokes down to fractions of a millimeter in size, strokes not typically visible on paper. We categorize strokes as "noise" when they are clearly not identifiable clock elements (hands, numbers, tick-marks, etc.), but are contained within the clock face circle as part of the clock drawing. We hypothesize that presence and length of noise strokes differentiates Vascular Dementia (VaD) from Healthy Controls (HC), Amnestic MCI (aMCI), Vascular Cognitive Impairment (VCI), and Alzheimer's Dementia (AD).

PARTICIPANTS

248 subjects from the ClockSketch Consortium were administered the dCDT (HC=58, aMCI=71, VCI=27, AD=55, VaD=37). On the MMSE, VaD and AD were similar (p<.99) while other groups differed (p<.01). HC were younger than other groups (p<.01). AD were less educated than HCs (p<.001).

METHODS

Following procedures described by Kaplan* (1994), subjects were instructed to draw clocks to command and copy with the hands set for "ten after eleven." Clocks were scored using the dCDT program and scoring accuracy was verified. We created a histogram determining the frequency of noise stroke lengths (NSL) from a diverse patient data sample (109 dCDT tests, 218 total clocks; frequency = 345; length range = 0.0 - 8mm). Based on the distribution of the stroke lengths, four NSL categories were defined: Imperceptible = 0mm; Small < 0.3mm; Medium = between 0.3-0.7mm, Long > 0.7mm. We compared groups for noise lengths and location.



RESULTS

VaD (2.32 ± 4.89) produced more command NSL-long than all other groups (HC= 0.16 ± .49, p=.000; aMCI= 0.49 ± 1.24, p=.001; VCI= 0.74 ± 1.35, p=.031; and AD= 0.60 ± 1.25, p=.002). NSL-Imperceptible and NSL-Small frequencies did not differ. Copy NSL-Long were more frequent for VaD (0.51 ± 1.07) vs. HC (0.03 ± 0.18, p=.01) only. Command NSL-Long were more frequently located in the upper left quadrant for VaD (1.3 ± 3.93) vs. HC (0.07 ± 0.32, p=.002), aMCI (0.17 ± 0.45, p=.004) and AD (0.22 ± 0.498, p=.01), but not VCI (0.3 ± 0.61, p=.09) and upper right quadrant for VaD (0.76 ± 2.80) vs. HC (0.03 ± 0.26, p=.05) only. Quadrant location was ns for the Copy condition.

CONCLUSIONS

Noise strokes differentiate between groups by length and location and may represent decision-making difficulty in time-setting. Noise strokes are previously unstudied small, non-random phenomena that may indicate impairment even in otherwise correct drawings.

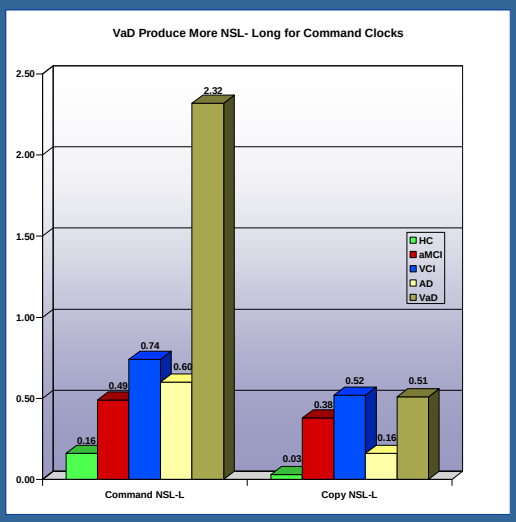


Figure 1. The pen stroke located by the number 11 is an example of an upper left quadrant command Long noise stroke (NSL>0.7mm) produced by VaD patients.

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*Freedman, M, Leach, L., Kaplan, E., Winocur, G., Shulman, K., Delis, D. (1994). *Clock Drawing: A Neuropsychological Analysis.* New York: Oxford Univ Press.