The Digital Clock Drawing Test (dCDT) - IV: Clock Drawing Time and Hand Placement Latencies in Mild Cognitive Impairment and Dementia

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OBJECTIVE

The dCDT scoring system analyzes clock drawings obtained with a digitizing pen (Anoto Inc.) that works as an ordinary ballpoint while capturing time-stamped pen positions 80 times/second, accurate to ± 002". This data enables precise measurements of pen stroke duration and location, as well as time elapsed between strokes (inter-stroke latencies). We hypothesize that Total Clock Drawing Time (TCDT) and latencies prior to placing the first (PFH-L) and second (PSH-L) clock hands will differentiate Subcortical Vascular Dementia (VaD) from Healthy Controls (HC) and other dementias [amnesic Mild Cognitive Impairment (aMCI), Vascular Cognitive Impairment (VCI), senile onset Alzheimer's Dementia (AD)].

PARTICIPANTS

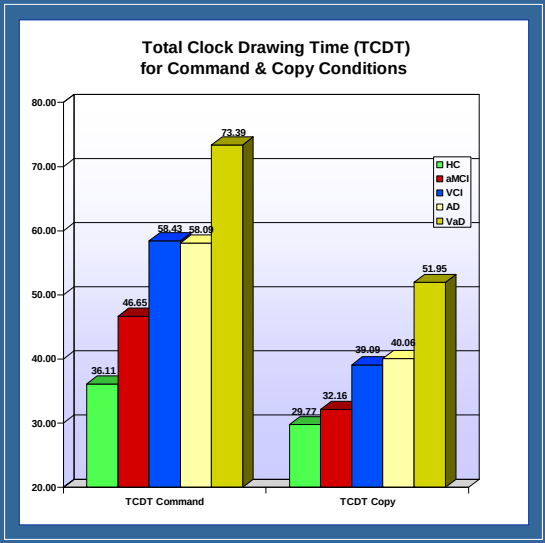
248 subjects from the ClockSketch Consortium were administered the dCDT (HC=58, aMCI=71, VCI=27, AD=55, VaD=37). On the MMSE, VaD (22.41 ± 2.20) and AD were similar (22.67 ± 3.11, p=.99) and differed from all other groups (HC= 29.19 ± .95; aMCI=27.38 ± 1.19; VCI= 25.39 ± 2.98, p=.001). HC (56.37 ± 12.84) were younger than other groups (aMCI= 75.27 ± 8.03; VCI= 78.79 ± 5.74; AD= 79.11 ± 5.12; VaD= 81.23 ± 5.02, p=.001). AD (13.44 ± 2.75) were less educated than HCs (16.65 ± 3.12, 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." The dCDT computerized scoring system automatically classified all pen strokes; these classifications were reviewed by the clinician administering the test using the program's Classification Assist Tool and adjusted if the clinician determined it necessary. Drawings were anonymized and pen stroke classifications were independently verified.

Table 1. Pre-First and Pre-Second Hand Latencies (mean & standard deviations; secs)

	Hand Order	HC	aMCI	VCI	AD	VaD
Command	First Hand	2.93 (2.11)	4.09 (3.91)	4.28 (4.23)	5.71 (5.29)	6.98 (6.82)
	Second Hand	1.62 (1.83)	2.15 (2.88)	1.02 (1.00)	2.04 (2.58)	2.28 (3.19)
Copy	First Hand	1.49 (1.55)	1.79 (1.61)	2.22 (2.22)	2.90 (4.21)	4.16 (5.25)
	Second Hand	1.06 (0.75)	1.17 (0.98)	1.12 (0.57)	1.24 (1.06)	1.89 (2.48)



RESULTS

Between-group command TCDTs did not differ for VaD (73.39 ± 45.63) vs. VCI (58.43 ± 44.92) and AD (58.09 ± 33.99). TCDT for these groups was longer than aMCI (46.65 ± 29.55, p=.001) and HC (36.11 ± 14.61). Copy TCDT shortened for all groups, with VaD (39.09 ± 24.18) remaining longer than all other groups (HC= 29.77 ± 12.27, p=.000; aMCI= 32.16 ± 11.06, p=.000; VCI= 39.09 ± 24.82, p=.04; AD= 40.06 ± 20.16, p=.022). Command PFH-L did not differ for VaD (6.98 ± 6.82) vs. VCI (4.28 ± 4.23) and AD (5.71 ± 5.29). Command PFH-L for VaD were longer vs. aMCI (4.09 ± 3.91, p=.02) and HC (2.93 ± 2.11, p=.01). Copy PFH-L for VaD were also longer vs. aMCI and HC. Command PSH-Ls did not differ. Copy PSH-Ls differed for VaD vs. aMCI (p=.002) and HC (p=.001).

CONCLUSIONS

Consistent with prior research, AD patients improve in total drawing time from command to copy. This finding is extended to VaD. VaD and AD TCDT improved from command to copy; however AD improved to the HC level, while VaD remained slower than all other groups. Longer command PFH-Ls vs. PSH-Ls suggest hand placement decision-making for both hands may occur prior to placing the first hand. The lack of difference between groups for Command PSH-L suggests that simple motor speed may only partially account for the VaD longer PFH-Ls. Drawing latencies, particularly Pre-First Hand latencies, may be useful in assessing and monitoring decision-making in patients with suspected cognitive decline.

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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.