

Digital In-air Clock Drawing Time Is Associated With Amyloid Pet Positivity In Mild Cognitive Impairment

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INTRODUCTION

- The Clock Drawing Test (CDT) has evolved from a qualitative bedside assessment to a process-based quantitative measure through digital technology (digital CDT, dCDT), enabling capture of temporal drawing behaviors.
- Among these metrics, *in-air time*—the time spent with the pen off the drawing surface—has been shown to increase in early Alzheimer's disease (AD) and mild cognitive impairment (MCI), offering superior discrimination from healthy controls compared with traditional CDT scoring.
- We hypothesized that in-air time alone may serve as a sensitive marker of amyloid pathology in MCI. This study examined whether dCDT in-air time differs between amyloid-negative and amyloid-positive MCI patients.

METHODS

- Patients with MCI, defined according to Petersen's criteria, were recruited from the Memory Disorder Clinic at Jeonbuk National University Hospital (Jeonju, Korea) between July 2021 and December 2023.
- All participants underwent clinical interviews, neuropsychological testing, MRI, laboratory evaluations, and amyloid PET imaging.
- Amyloid status was determined using 18F-flutemetamol PET with visual rating.
- The dCDT was administered using a digital pen and tablet.
- Extracted metrics included total test time, number of strokes, on-surface time, in-air time, and their proportional measures (% of total time).

RESULTS

- Median total drawing time and number of strokes did not differ significantly between amyloid-negative and amyloid-positive MCI groups.
- Absolute on-surface time (seconds) and in-air time(seconds) were also comparable.
- However, amyloid-positive MCI patients demonstrated significantly higher on-surface time (%) ($p = 0.0023$) and in-air time (%) ($p < 0.0001$) compared with amyloid-negative patients. Each 1-percentage-point increase in in-air time (%) was associated with an approximately 11% higher odds of amyloid PET positivity. In-air time (%) showed slightly better discriminative performance than the Mini-Mental State Examination

CONCLUSIONS

- Absolute on-surface time (seconds) and in-air time(seconds) were also comparable. However, amyloid-positive MCI patients demonstrated significantly higher on-surface time (%) ($p = 0.0023$) and in-air time (%) ($p < 0.0001$) compared with amyloid-negative patients.
- Each 1-percentage-point increase in in-air time (%) was associated with an approximately 11% higher odds of amyloid PET positivity.
- In-air time (%) showed slightly better discriminative performance than the Mini-Mental State Examination.

REFERENCES

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Figure. The digital pen trajectory was recorded during the copying of the simplified RCFT.