



## Questioned Documents Section - 2012

### J15 Kinematic Evidence of Parkinsonism in the Handwriting of Patients With Alzheimer's Disease

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After attending this presentation, attendees will understand why some individuals with Alzheimer's Disease (AD) exhibit handwriting characteristics that resemble Parkinson's disease.

This presentation will impact the forensic science community by providing: (1) a neurobiological understanding of why signatures change in Alzheimer's disease; and, (2) an empirical support for a difference in handwriting and signatures between two forms of dementia.

The principle handwriting impairment in early Alzheimer's disease (AD) has a cognitive-linguistic basis comprised of lexical or semantic errors, word selection, and phonological substitutions. The literature on handwriting among patients with mild or early AD generally suggests little or no graphic motor impairment. Later in the course of the disease writing samples can show more graphic motor disturbances. While there have been numerous published works characterizing the linguistic aspects of handwriting impairment in AD, debate remains as to whether the decline in handwriting in AD reflects the pathological change in frontal cortical integrity, giving rise to cognitive and psychomotor deficits or pathological change in sub-cortical basal ganglia integrity, giving rise to Parkinsonian features. This distinction has relevance to forensic document examiners charged with the task of authenticating signatures and handwriting from older individuals with suspected dementia.

A study was conducted of handwriting kinematics in AD. AD patients were sub-grouped according to scores on a standard clinical assessment that suggested either the presence or absence of Parkinsonian neuropathology. Patients with clinical signs of Parkinsonism comprise a subtype of AD known as Dementia with Lewy Bodies or DLB. The study goals were to determine whether kinematic analyses of handwriting movements support previous literature that handwriting is preserved in AD and to identify kinematic parameters in signatures and handwriting that might distinguish AD from DLB. A standard laboratory assessment of handwriting was employed. Briefly, subjects were instructed to draw concentric circles, write series of the letter 'l' and alternating "lleelle", write a standard sentence, and sign their signature five times using an inkless pen on a digitizer tablet. MovAlyzeR® software was used to acquire and process multiple kinematic variables from each pen stroke.

Results indicated that as a group, AD writers exhibited longer stroke durations, lower stroke velocities, and greater number of acceleration peaks (inversions) per stroke. Overall, these features were not significantly different from those of healthy writers. However, AD patients were more variable as a group than healthy writers suggesting that some AD patients may have significantly impaired handwriting. One likely source of this variation could be the presence of motor impairment consistent with the provisional diagnosis of DLB. Further analyses of signature and handwriting movements in DLB patients showed slower movement velocities, longer stroke durations, decreased stroke length, and an increased number of acceleration inversions versus non-DLB AD patients. The present findings indicate that motor aspects of handwriting may be impaired in AD patients, particularly those who met clinical criteria for DLB, and that the nature of this impairment may not have a solely cognitive or linguistic basis.

**Alzheimer's Disease, Handwriting Kinematics, Parkinsonism**