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The New Qualitative Scoring MMSE Pentagon Test (QSPT) as a Valid Screening Tool between Autopsy-Confirmed Dementia with Lewy Bodies and Alzheimer's Disease

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Abstract

Visual-constructional apraxia is a prominent feature of dementia with Lewy bodies (DLB) that might help to clinically distinguish it from Alzheimer's disease (AD). The main goal of this study was to assess performance on the copy intersecting-pentagon item of the Mini-Mental State Examination with the new Qualitative Scoring method for the Pentagon copy Test (QSPT). In order to determine which aspects of the drawings might differentiate DLB from AD, pentagon drawings of autopsy-verified DLB ($n = 16$) and AD ($n = 15$) patients were assessed using the QSPT. The qualitative scoring encompasses the assessment of different parameters of the drawing, such as number of angles, distance/intersection, closure/opening, rotation, and closing-in. The QSPT scores were compared between groups using linear analyses and artificial neural network analyses at four different time points. Linear analyses showed that during the first evaluation, number of angles was the only parameter that showed a significant difference between DLB and AD patients. A gradual decline in other parameters and total pentagon score occurred in both groups during subsequent years, with greater decline for the DLB group. The artificial neural network analyses using auto-contrastive maps showed that, with disease progression, DLB became related to relatively lower qualitative pentagon scores, whereas AD became related to relatively higher qualitative scores. These findings suggest that the QSPT might be a sensitive measure of visuo-constructive abilities able to differentiate DLB from AD at disease onset and as the diseases progress, but further studies on larger population are necessary in order to establish its clinical relevance.

Keywords

Alzheimer's disease; autopsy-confirmed; copy of pentagons; dementia with Lewy bodies

INTRODUCTION

Dementia with Lewy bodies (DLB) is recognized as the second most common cause of dementia in older adults after Alzheimer's disease (AD). DLB shares several clinical features with AD, including the insidious onset of cognitive deficits that gradually worsen over time and ultimately result in complete functional dependence. In addition to cognitive impairment, the core clinical features of DLB include visual hallucinations, fluctuating attention, and spontaneous extrapyramidal signs [1]. Patients with DLB may display a different pattern of cognitive decline in comparison to AD, with worse performance on attentional and executive tasks [2, 3] and, especially, on tests of visuospatial/constructional abilities [4–7].

Comparisons of the rate of cognitive decline in patients with autopsy-confirmed DLB or AD have yielded mixed results. Some studies showed similar levels of cognitive decline in the two diseases [8–11] and others reported more rapid decline in DLB than in AD [12, 13]. Both disorders are marked by substantial individual variation in the rate of progression, but this variability may be more pronounced in patients with DLB than in those with AD [14].

The prominent loss of visuospatial abilities is listed among the supporting diagnostic criteria that define the syndrome of DLB [1] and visuospatial deficits may be a particularly salient cognitive marker of the disease [15]. The level of visuospatial impairment in patients with DLB is disproportionately severe in comparison to their deficits in other cognitive domains [16, 10]. DLB patients consistently exhibit excessively severe deficits in visuospatial, visuoperceptual, and construction abilities relative to patients with probable AD [4–6, 16, 17].

The performance of DLB patients on construction tasks is affected by impairments in visual perception and pre-attentive visual processing. These early aspects of bottom-up visual cognition are typically more impaired in DLB than in AD, and they likely play an important role in their more severe construction deficits [18]. Calderon et al. [19] compared DLB patients with AD patients on the Visual Object and Space Perception Battery [20], a set of tasks that emphasize bottom-up aspects of visual cognition. DLB patients showed more severe impairments than AD patients on tests tapping both ventral (Fragmented Letters and Object Decision) and dorsal (Cube Analysis) visual stream functions. A similar result was found by Mosimann and colleagues [21] using tests of object and form perception (ventral stream) and tests of dot position and motion perception (dorsal stream). Based on these results, visual constructional apraxia is considered a prominent feature of DLB that may help to clinically distinguish it from AD [6, 15, 22].

Differentiating between DLB and AD at onset and as disease progresses is very important because patients with DLB may show a different response than patients with AD to acetylcholinesterase inhibitors [23] and an abnormal sensitivity to neuroleptic drugs [24]. In

2005, the DLB diagnostic criteria were modified to include three new features in a category termed “suggestive features”. With this revision, clinically probable DLB is represented by two or more core features (fluctuations, parkinsonism, or visual hallucinations), or by one core feature plus one suggestive feature. The suggestive features include: severe neuroleptic sensitivity, reduced basal ganglia dopamine uptake on functional imaging, and an REM sleep parasomnia called REM sleep behavior disorder (RBD) [1]. Recently, Ferman et al. [25] showed that the inclusion of RBD improves the diagnostic classification of DLB. In previous studies using postmortem diagnosis as the gold standard, the clinical diagnostic accuracy of DLB was poor, ranging from 34 to 65% [26, 27]. However, even if this percentage is increasing and recent studies [28] demonstrate the validity of the pathological criteria of the Third Consortium on Dementia with Lewy bodies, it still remains difficult to identify DLB cases.

Due to the current difficulty in correctly identifying DLB in clinical practice, and the importance of distinguishing it from AD as early as possible in the disease course, we investigated the possibility of differentiating between the two variants of dementia using a qualitative and quantitative method of scoring the ability of patients to copy the intersecting pentagons figure from the Mini-Mental State Examination (MMSE) [29]. We used the Qualitative Scoring MMSE Pentagon Tests (QSPT) [22] method to retrospectively assess, at four different time points, the intersecting pentagon drawings of autopsy-confirmed AD and DLB patients. Although all patients had undergone a comprehensive neuropsychological examination, we limited our analyses to the pentagon drawings as it is the measure of visuo-constructional ability that was assessed over time, and it has been shown to be a good cognitive marker of DLB *ab initio* [30].

Our intent was to determine if the qualitative scoring of pentagon drawings could be a good cognitive marker for distinguishing DLB from AD at disease onset and as disease progresses. Furthermore, since QSPT evaluates different qualitative aspects of pentagons drawing, such as number of angles, rotation, and opening/closure, the research was also designed to reveal if patients suffering from DLB or AD fail in diverse ways that reflect the impairment of selective cognitive processes that are the expression of neuropathological alterations that differ in the two syndromes.

MATERIALS AND METHODS

Participants

Patients with dementia who were confirmed at autopsy to have DLB ($n = 15$) or AD ($n = 16$) were included in the present retrospective study. All patients were recruited from the Shiley-Marcos Alzheimer's Disease Research Center (ADRC) of the University of California, San Diego (UCSD) where they received yearly physical, neurologic, and neuropsychological assessments. All participants met the following inclusion criteria: 1) autopsy revealed no significant pathological processes (e.g., hippocampal sclerosis, metabolic encephalopathy, or infarct with a clinical history of stroke) other than DLB or AD; 2) MMSE, including the pentagon copy performance, had been completed at four different time points each separated by approximately one year, and 3) the interval between the last evaluation and death was less than 24 months. The mean interval between the first evaluation and death for AD and

DLB was 5.69 and 4.13 years, respectively. In all cases, the annual evaluations examined included the first year in which the patient received a diagnosis of dementia or any other cognitive deficit, and three years, two years, and one year before death. The clinical diagnoses of AD patients at the first time point examined was probable AD ($n = 14$), possible AD ($n = 1$) or normal/mild cognitive impairment (MCI; that progressed to dementia) ($n = 1$). The clinical diagnoses of DLB patients at the first time point examined was DLB (or Lewy Body Variant of AD; $n = 6$), probable AD ($n = 7$), possible AD ($n = 1$), or normal/MCI (that progressed to dementia) ($n = 1$). It should be noted, however, that 70% of these DLB patients were tested before actual DLB clinical criteria [2] had been developed. The mean age, years of education, MMSE scores at each time point, and interval between the last evaluation and death are shown in Table 1. The two groups did not differ in age ($t_{(1,29)} = 1.985$, $p = 0.057$), education ($t_{(1,29)} = -0.177$, $p = 0.861$), gender ($\chi^2 = 0.987$, $p = 0.320$), interval between last evaluation and death ($t_{(1,29)} = 0.052$, $p = 0.959$), or MMSE score at any of the four time points (first year in which they received a diagnosis of dementia or any other cognitive deficit: $t_{(1,29)} = -0.053$, $p = 0.958$; three years prior to death: $t_{(1,29)} = -1.227$, $p = 0.230$; two years prior to death: $t_{(1,28)} = -0.731$, $p = 0.471$; one year prior to death: $t_{(1,29)} = -0.998$, $p = 0.326$).

The research protocol was reviewed and approved by the human subjects review board at the University of California, San Diego. Informed consent to participate in the present investigation was obtained at the point of entry into the longitudinal study from all patients or their caregivers consistent with California State law. Informed consent for autopsy was obtained at the time of death from the next of kin.

Neuropathologic examination and diagnosis

Autopsy was performed within 12 hours of death using a protocol described by Terry and colleagues [31]. The left hemibrain was fixed by immersion in 10% formalin for 5–7 days. Paraffin-embedded blocks from midfrontal, rostral superior temporal and inferior parietal neocortex, hippocampus, entorhinal cortex, basal ganglia/substantia innominata, mesencephalon, and pons were cut at 7- μ m thickness for hematoxylineosin (H & E) and thioflavin-S counts. Total plaques, neuritic plaques, neurofibrillary tangle (NFT) counts, and the presence or absence of Lewy bodies, were determined by a single examiner. A modified Braak stage was obtained for each case using methods described by Hansen and colleagues [32]. The modified Braak stage for AD pathology involves counting the number of NFT in at least five neuron clusters in layer two of the entorhinal cortex and then averaging the results. Cases with modified Braak Stage I to IV have fewer than 18 tangles on average in layer two of the entorhinal cortex and sparse neocortical tangles. Modified Braak Stage V cases have moderate numbers of tangles in at least two neocortical sections. In modified Braak Stage VI, all neocortical areas assessed have at least moderate numbers of tangles. Lewy bodies were absent in cases of “pure” AD.

The DLB cases met consensus criteria for the pathologic diagnosis of DLB based on H & E staining and anti-ubiquitin immunostaining, and anti- α -synuclein immunostaining. Cases were only construed as DLB if Lewy bodies were found in multiple brain stem nuclei (e.g., the locus coeruleus, substantia nigra, and/or nucleus basalis of Meynert) and the superior

temporal gyrus neocortex. Thus, all Lewy body cases in the study qualified for either the “limbic” (transitional) or “diffuse neocortical” categories of DLB [33].

Procedure

The intersecting pentagons copy sub-item was administered as part of the MMSE during an annual comprehensive neuropsychological evaluation. The neuropsychological test battery has been described in detail [34] and includes measures of memory, language, executive function, attention, and visuospatial abilities. Participants were tested individually in a quiet, well-lit room. All of the pentagon drawings were re-scored using the new QSPT [22] methods (see Table 2 for detailed description). The new scoring method included five parameters as follows: 1) numbers of angles (0–4 points); 2) distance/intersection between the two figures (0–4 points); 3) closing/opening of the contour (0–2 points); 4) rotation of one or both pentagons (0–2 points); and 5) closing-in (0–1 points). A total score corresponding to the sum of individual scores of each parameter ranged from 0 to 13. Tremor was ignored in scoring. When participants executed more than one copy of the pentagons, the best copy was scored.

Statistical analysis

The analyses were performed using both standard linear regression models and a data mining analysis method based on artificial neural networks, the Auto-contractive map (Auto-CM). The Auto-CM analysis uses a specific data mining learning algorithm to find consistent patterns and/or systematic relationships and hidden trends and associations among variables; in this case specific relationships between QSPT scores and the diagnostic entities of DLB and AD.

Linear analysis

The scores of AD and DLB patients on the qualitative QSPT measures were compared at each time point using Student's *t*-tests. Cohen's *d* was used to measure effects sizes for these analyses. Discriminant analysis was also performed to confirm these results. Repeated measures ANOVAs were carried out with QSPT total scores and qualitative scores to examine change in performance over time in the two groups.

Auto-CM analysis

The association scheme among variables was explored with Auto-CM analysis. Auto-CM is a novel kind of unsupervised artificial neural network approach developed at Semeion Research Centre that makes it possible to “spatialize” the associations between variables of interest. This method is based on an artificial adaptive system that is able to define the association strength between each variable and all others in any dataset. Auto-CM uses a specific data-mining learning algorithm to find consistent patterns and/or systematic relationships and hidden trends and associations among variables. The Auto-CM connections matrix, filtered by a minimum spanning tree algorithm, generates a graph (i.e., a connectivity map) that spatially represents the relevant associations among the entered variables. Within the connectivity map, non-linear associations are preserved, connection schemes are explicit, and complex dynamics of adaptive interactions are captured. The

architecture and mathematics of Auto-CM is described in detail elsewhere [35, 36], and its biological relevance has been demonstrated previously [35, 37]. In the present study, the diagnosis (DLB or AD) and the individual qualitative scores and total score from the QSPT were inserted in the analyses. Separate Auto-CM analyses were carried out for each time point. This procedure elucidated changes in the patterns of associations between QSPT parameters and diagnostic labels over time.

RESULTS

Standard linear analysis results

The mean QSPT total score and parameter scores achieved by DLB and AD patients at each of the four evaluations are shown in Table 3. At the first evaluation, 33.3% of DLB and only 6.3% of AD subjects failed on the number of angles and this parameter resulted significantly worse in DLB than in AD ($t_{(1,28)} = 2.088$, $p = 0.046$, $d = 0.74$). Three years before death, the groups did not differ significantly on any parameters. Two years before death, the total qualitative pentagons score ($t_{(1,29)} = 2.063$, $p = 0.048$, $d = 0.73$) and closure/opening parameter ($t_{(1,29)} = 2.689$, $p = 0.012$, $d = 0.95$) were significantly worse in the DLB group than in the AD group. One year before death, only the rotation parameter was worse in DLB than AD ($t_{(1,29)} = 2.163$, $p = 0.039$, $d = 0.78$). These results are also confirmed by the discriminant analysis. Repeated measure ANOVAs showed a significant general decrease over time in both groups on numbers of angles ($F_{(3,87)} = 13.593$; $p < 0.0001$), distance/intersection between the two figures ($F_{(3,87)} = 8.957$; $p < 0.0001$), rotation of one or both pentagons ($F_{(3,87)} = 17.035$; $p < 0.0001$), closing-in ($F_{(3,87)} = 2.766$; $p = 0.047$), and total score ($F_{(3,87)} = 14.377$; $p < 0.0001$).

The QSPT total score on the pentagon drawing test showed generally worse degradation with disease progression in DLB patients compared with AD patients. Two years before death, DLB patients showed a significantly lower total score compared with AD patients ($F_{(1,30)} = 4.255$; $p = 0.048$; see Fig. 1). An example of differential decline in an AD patient and an equally-demented DLB patient is shown in Fig. 2.

Artificial neural network results

Auto-CM-derived connectivity maps that illustrate the most relevant associations present in the database are shown across the four time points in Fig. 3. These maps show that differences in the distribution of associations between QSPT scores and DLB and AD diagnostic labels grew larger across the four time points as disease progressed. At time T0 (the first year in which patients received a diagnosis), DLB was directly associated with number of angles high and AD with intersection high and total pentagons high. Number of angles high was at two degrees of separation in AD and one degree in DLB. Over subsequent evaluations (i.e., T1 three years before death, T2 two years before death, and T3 one year before death), DLB and AD separated on the maps with DLB moving toward low total QSPT scores and AD moving toward high QSPT scores indicating that poor pentagon drawing performance was a more salient feature of DLB than AD. In addition, associations between diagnosis and qualitative measures changed with DLB moving in particular toward errors in rotation. By the final evaluation (T3), the diagnosis of AD was directly associated

with high score of intersection and through this node to high total QSPT scores and high qualitative scores for rotation, number of angles and closure. In contrast, the diagnosis of DLB was associated through low rotation scores with low total QSPT scores and low qualitative scores for number of angles and intersection. These results indicate that these qualitative parameters have a good ability to distinguish between the two forms of dementia.

DISCUSSION

The results of the present study show that quantitative and qualitative scores on the intersecting pentagon copy item of the MMSE derived with the QSPT method [22] provide sensitive measures of visuo-constructive abilities able to differentiate DLB from AD at disease onset and as disease progresses. Patients with DLB performed worse than patients with AD on a qualitative measure of the number of angles produced in the drawing at the initial evaluation (at least more than nine years before death), and showed faster decline over time in QSPT total score and qualitative scores for closure/opening and rotation of the drawing. The results of Auto-CM analyses did not match the linear analysis at time T0, but supported these findings in the following time points, showing that over time DLB and AD separated on the maps with DLB moving toward relatively low total QSPT scores and AD moving toward relatively high QSPT scores. In addition, associations between diagnosis and qualitative measures changed over time with DLB becoming associated with low rotation scores, low total QSPT scores and low qualitative scores for number of angles and intersection, and AD becoming associated with high score of intersection, total QSPT scores, rotation, number of angles, and closure.

The present results are consistent with those of a number of other studies that show deficits in visuospatial, visuo-perceptual and construction abilities are greater in patients with DLB than in equally demented patients with AD [6, 16, 38]. They also support the view that tests of visuo-construction abilities might be useful and valid tools for differentiating between the two syndromes. Recognizing the current difficulty in correctly distinguishing DLB from AD early in the course of disease, we investigated the possibility that a qualitative method for scoring the pentagons copy item from the MMSE [22] could contribute to the early differentiation of the two variants of dementia. Our intent was to elucidate and compare the specific parameters of the pentagons copy in which DLB and AD patients failed.

Through the QSPT method, we explored five different qualitative aspects of drawing production: number of angles, distance/intersection, closure/opening, rotation, and closing-in. The only qualitative parameter that showed a significant difference between DLB and AD patients during the first year in which they received a clinical diagnosis was the number of angles. DLB patients were worse than patients with AD. Because drawing the correct number of angles requires subjects to generate a visual image of the pentagons from semantic memory [39], this observation suggests that early impairment on the pentagon copy task in DLB could be related to a degradation of the mental representation of pentagons rather than simply to graphic or visuo-perceptual difficulties. Although copying tasks are usually thought to assess only visuo-constructional abilities rather than additional lexical-semantic mechanisms and imagery abilities engaged in free drawing [40], these non-constructional cognitive abilities might be beneficial for copying highly-known and well-

defined complex shapes. Intact semantic information about a pentagon configuration, such as the correct number of angles, might help distinguish it from similar figures like a triangle, rhombus, or hexagon and enhance the ability to copy the figure. Thus, the finding that patients with DLB performed significantly worse than patients with AD in drawing the correct number of angles may indicate that they have a degraded mental representation of the pentagons early in the course of the disease.

As disease progressed, patients with DLB began to perform significantly worse than patients with AD on parameters related to visuo-perceptual abilities that can be performed by referring to an external representation. The groups did not differ in qualitative performance three years prior to death, but two years and one year prior to death patients with DLB performed significantly worse than patients with AD on closure/opening and rotation parameters. These findings are consistent with previous studies that show disproportionately severe visual-processing and visual-perception deficits in DLB relative to AD (e.g., [19] and Mitolo et al., unpublished results) and suggest that they may play an important role in DLB patients' construction deficits [18].

Another parameter analyzed with the QSPT method is "closing-in". This parameter reflects the degree to which a patient's drawing physically abuts or overlaps the model that is to be copied. Closing-in is considered by some investigators to be a general neuropsychological marker of dementia that increases with severity of disease [41, 42]. Although previous studies suggest that closing-in is more frequent in AD than in DLB [42], this qualitative error was observed in only two AD and two DLB patients and did not distinguish between the groups.

We also used Auto-CM analyses to examine the distribution of associations between dementia diagnosis (i.e., DLB versus AD) and the QSPT qualitative parameter scores for pentagons copy. During the first year in which they received a diagnosis, the level of performance on qualitative parameters was not differentially associated with the two syndromes. However, as the diseases progressed, DLB became associated with low rotation score, low total QSPT scores, and low qualitative scores for number of angles and closure, and AD became associated with high score of intersection, high scores in total QSPT scores, and high qualitative scores for rotation, number of angles, and closure. The diverging patterns of associations for DLB and AD patients with disease progression shows the usefulness of examining qualitative parameters of pentagon copying performance with the Auto-CM analyses approach and suggests that the intersecting pentagon copy task scored with the QSPT method provides a valid cognitive screening tool for differentiating DLB from AD, particularly in later stages of disease.

In conclusions, our results demonstrate that the QSPT method provides additional neuropsychological information over the normal dichotomous pentagons copy score. This additional information at the beginning but also during the course of the disease could be helpful for beginning appropriate pharmacological treatment and planning specific cognitive training with the aim to improve those abilities that are getting worse with the disease, such as visuo-spatial functions. The pentagon copy, differently from other cognitive tools, is easily administered and it is a subtest of the MMSE, usually used as a screening test of

global mental functions. Furthermore, this qualitative evaluation of pentagons copy further characterizes the cognitive profile of DLB and might contribute to the differentiation of DLB from AD. Improved ability to identify individuals who are likely to develop the prototypical DLB syndrome has important treatment implications because the development of viable therapeutics is hindered by poor diagnostic sensitivity for DLB in the living population [38]. Thus, identification of valid cognitive screening tools that increase the correspondence between the DLB clinical phenotype in living patients and the presence of Lewy bodies at autopsy is important. The present results suggest that qualitative analysis of the pentagons copy task of the MMSE might be a valid screening tool, even though further studies on larger population are necessary in order to establish its clinical relevance.

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Figure 1.
Total QSPT score of AD and DLB patients at four time points.

Figure 2.
Examples of pentagons copy performance of an AD and DLB patients.

Figure 3.
Auto-CM in all the four time points: T0, T1, T2, T3.

Table 1

Mean and standard deviation (SD) values for demographic variables and MMSE of AD and DLB patients

	AD (n = 16)	DLB (n = 15)
Age	83.13 (5.74)	78.67 (6.76)
Education	15 (2.37)	15.2 (3.8)
Gender (M)	9	11
MMSE 1st diagnosis	24.81 (2.07)	24.5 (3.25)
MMSE 3 y before death	21.06 (6.83)	23.93 (6.15)
MMSE 2 y before death	18.27 (8.10)	20.47 (8.37)
MMSE 1 y before death	14.5 (8.44)	17.67 (9.22)
Interval between last test and death (mo)	9.31 (1.6)	9.20 (1.8)

Table 2

Qualitative scoring method for the pentagon copying test (QSPT) from Caffarra et al. [22]

Parameters	Performance scores	Assigned scores
1. Numbers of angles	10	4
	10±1	3
	10±2	2
	7–5	1
	<5 or >13	0
2. Distance/Intersection	Correct Intersection	4
	Wrong Intersection	3
	Contact without Intersection	2
	No contact, distance <1 cm	1
	No contact, distance >1 cm	0
3. Closure/opening *	Closing both figures	2
	Closing only one figure	1
	Opening both figures	0
4. Rotation **	Correct orientation of both figures	2
	Rotation of one figure (either one figure is absent or it is not a pentagon then it is not assessable)	1
	Rotation of both figures (or both not assessable like pentagons)	0
5. Closing-in	Absent	1
	Present	0
Total	Sum of 1–5	0–13

* Figure is considered close even though two sides do not touch each other but the distance is 1 mm.

** When there is not a figure or figure is not a pentagon (then rotation is not assessable) score is 0. When rotation is less than 45°, figure is not considered rotated. Tremor is ignored.

Table 3

Mean (and SD) pentagons scores achieved by the AD and DLB patients

	1st diagnosis of cognitive deficit			3 years before death			2 years before death			1 year before death		
	AD	DLB	p value	AD	DLB	p value	AD	DLB	p value	AD	DLB	p value
MMSE total	24.81 (2.07)	24.5 (3.25)	0.753	21.06 (6.83)	23.93 (6.15)	0.230	18.27 (8.10)	20.47 (8.37)	0.471	14.5 (8.44)	17.670 (9.22)	0.326
Numbers of angles	3.94 (0.25)	3.36 (1.08)	0.046 *	3.62 (1.02)	3.47 (1.12)	0.685	3.310 (1.01)	2.47 (1.85)	0.127	2.56 (1.31)	2.06 (1.71)	0.371
Distance/Intersection	3.69 (0.79)	3.28 (1.44)	0.343	3.81 (0.40)	3.2 (1.42)	0.109	3.19 (1.47)	2.27 (1.94)	0.146	2.87 (1.31)	2.87 (1.7)	0.068
Closure/opening	1.75 (0.45)	1.71 (0.47)	0.833	1.69 (0.60)	1.4 (0.74)	0.243	1.87 (0.34)	1.2 (0.94)	0.012 *	1.44 (0.73)	1.07 (0.96)	0.234
Rotation	1.5 (0.52)	1.14 (0.66)	0.109	1.25 (0.77)	1.07 (0.79)	0.522	1 (0.63)	0.6 (0.63)	0.089	0.75 (0.58)	0.33 (0.49)	0.039 *
Closing-in	1	1		1	1		1.1 (0.25)	0.90 (0.26)	0.168	0.87 (0.34)	0.87 (0.35)	0.947
Total	11.87 (1.08)	10.5 (3.27)	0.124	11.37 (2.42)	10.13 (3.23)	0.233	10.44 (2.76)	7.47 (5.01)	0.048 *	8.5 (3.65)	6.2 (4.39)	0.123
pentagons score												

* Significant differences with $p < 0.05$. Bold values refer to pentagons scores significantly different between AD and DLB patients.