

Pentagon Drawing Test: some data from Alzheimer's disease, Paraphrenia and Obsessive compulsive disorder in elderly patients

Juliana Francisca Cecato*

Abstract

Pentagon Drawing Test is a visuospatial and constructional praxis test and is part of the MMSE screening. The aim of this paper was to analyze the predictive function of the Pentagon's drawing test in elderly patients with organic and non-organic disorders. This is a cross-sectional study with 64 subjects over 60 years old and with at least two years of education. As the focus of this research we selected the pentagon copy of MMSE, according to the scale recommended by Bourke et al. (1995). The author established a 5-item-scale to evaluate the pentagonal design. Participants were divided into four groups: normal elderly for the control group (CG), elderly with Alzheimer's disease (AD), and elderly with non-organic disorders such as obsessive compulsive disorder (OCD) and late paraphrenia. The outcome show statistically significant differences among normal elderly (NC), AD, OCD and Paraphrenia in cognitive instruments, such as MMSE ($p > 0.0001$), CAMCOG ($p > 0.0001$), Pentagon drawing ($p = 0.006$) and Clock Drawing Test by Mendez scale ($p > 0.0001$). ROC curves' analyses showed the greatest AUC in the pentagon drawing for the diagnosis AD (AUC = 0.756; $p = 0.010$), and sensitivity and specificity, respectively, 100% and 64%. It can be concluded the PDT has the confluence of information (cognitive and motor) a more robust confluence than other simplified instruments such as the MMSE.

Keywords: Aged - Neuropsychological tests – Diagnosis - Gerontology.

La prueba de dibujo Pentágono: datos de la enfermedad de Alzheimer, Paraphrenia y el trastorno obsesivo compulsivo en los pacientes de edad avanzada

Resumen

La prueba de dibujo Pentágono: es un test de habilidades de análisis visoespacial y es parte de la proyección MMSE. El objetivo de este trabajo fue analizar la función predictiva de la prueba de dibujo del Pentágono en los pacientes de edad avanzada con trastornos orgánicos y no orgánicos. Este es un estudio transversal con 64 sujetos por encima de 60 años de edad y con al menos dos años de estudio. El foco de esta investigación, selecciona la copia del pentágono del MMSE, de acuerdo con la escala recomendada por Bourke et al. (1995). Este autor estableció una escala con 6 elementos para evaluar el diseño pentagonal. Los participantes fueron divididos en cuatro grupos: ancianos normales que formaron el grupo control (GC), personas mayores con enfermedad de Alzheimer (AD), de edad avanzada con trastornos no orgánicos tales como el trastorno obsesivo compulsivo (TOC) y paraphrenia tarde. El resultado muestra diferencias estadísticamente significativas entre los ancianos normal (NC), AD, TOC y Paraphrenia en los instrumentos cognitivos, tales como MMSE ($p > 0,0001$), CAMCOG ($p > 0,0001$), el Pentágono dibujo ($p = 0,006$) y el test del reloj por Méndez escala ($p > 0,0001$). análisis ROC curvas mostraron la mayor AUC fue encontrado en el pentágono dibujo para el diagnóstico de AD (AUC = 0,756; $p = 0,010$), y la sensibilidad y la especificidad, respectivamente, 100% y 64%. Se puede concluir, que el PDT tiene la confluencia de la información (cognitivo y motor) más robusta que la otra simplifica instrumentos tales como el MMSE.

Palabras clave: Anciano - Pruebas Neuropsicológicas – Diagnóstico - Gerontología.

Introduction

Cambridge Examination for Mental Disorders of the Elderly (CAMDEX) is an instrument used for the diagnoses of mental disorders in the elderly based on the structured interview (Roth *et al.*, 1986). It includes a cognitive examination (CAMCOG) which has the Mini Mental State Examination (MMSE), Clock Drawing Test (CDT) and other cognitive items. Pentagon drawing test (PDT) is one of these cognitive items that includes the praxis evaluation of CAMCOG total score (Roth *et al.*, 1986).

The evaluation of mental and personality disorder by drawing tests (praxis) includes a large spectrum of diseases with the inability to make a

qualified or learned act (Cruth, Rossor & Warrington, 2007; Lynne, 2006). Impairment of psychomotor activities and difficulties in motor functions caused by apraxia are some of the most distressing features of Alzheimer's Disease (AD). This neurological and organic syndrome mainly affects the frontal lobe, causing loss of ability to perform precise movements and gestures (Giannakopoulos, Duc & Gold, 1998).

Paraphrenia is a non-organic disorder classified as a form of psychosis that may be present in dementia, but with a much lower frequency than the other psychotic symptoms (Martinelli, Cecato, Montiel & Bartholomeu, 2013; Sadock & Sadock, 2007). Paraphrenia is a kind of schizophreniform psychosis, with late onset in which delusions generally arise

* Faculdade de Medicina de Jundiaí. São Paulo, Brasil. E-mail: cecatojuliana@hotmail.com

accompanied by hallucinations (Gupta, Bassett, Iftene & Bowie, 2014; Martinelli et al., 2013; Sadock & Sadock, 2007). Paraphrenia's term constitutes an indication of a progressive course and refers to a systematic and delusional condition (Sadock & Sadock, 2007). They refer to late-onset schizophrenia as clinically indistinguishable from the disorder as a whole, with an onset after 45 years old; more frequent in women and with the most common paranoid symptoms. The prognosis is visually satisfactory, since patients show improvement after drug administration (Sadock & Sadock, 2007).

Strub & Black (2000) recommend copying of drawings to evaluate the organic and non-organic disorders. Pentagon drawing test is part of MMSE (Folstein, Folstein & McHugh, 1975) and consists of two pentagons connected, with the overlapping parts making a rhombus shape (Fountoulakis et al., 2011).

Objective

To analyze the predictive function of the Pentagon drawing test in elderly patients with organic and non-organic disorders.

Method

This is a cross-sectional study with 64 elderly subjects over 60 years old and with at least two years of education. All participants were attended by a geriatrician in Geriatrics and Gerontology Ambulatory in Jundiaí Medical School, from April 2011 to December 2014.

As part of the ambulatory history protocol, patients also underwent neuropsychological evaluation. After gathering all the anamnesis (neuroimaging, laboratory and neuropsychological examinations), subjects were sent to the geriatrician to receive the diagnosis and treatment.

Instruments

The cognitive tests applied are Mini-Mental State Examination (MMSE) (Folstein et al., 1975), the Cambridge Cognitive Examination (CAMCOG) (Roth et al., 1986), Geriatric Depression Scale (GDS) (Yesavage et al., 1983) and Pfeffer Functional Activities Questionnaire (PFAQ) (Pfeffer et al., 1982). For the approach of this research we selected the copy of the pentagon of MMSE, according to the scale recommended by Bourke & Castleden (1995). They established a scale with 6 items to evaluate the pentagon design in patients with Alzheimer's disease (AD). The established scores were as follows: 6 points correct copy; 5 points for two overlapping pictures, one of a pentagon; 4 points for two overlapping pictures; 3 points for two figures not overlapping; 2 points for a closed

figure and 1 point when the drawing does not show the shape of a closed figure. For this test a figure of the pentagons overlapping is shown and a verbal command is given. Pentagon drawing test evaluates verbal comprehension, visuospatial and constructional skills and executive functions.

Diagnostic groups

Participants were divided into four groups: normal elderly for the control group (CG), elderly patients with Alzheimer's disease (AD), elderly patients with non-organic disorders such as obsessive compulsive disorder (OCD) and late paraphrenia. To make AD group, patients with mild dementia (CDR = 0.5) and severe dementia (CDR > 3) were excluded. To set the severity of dementia the Clinical Dementia Rating was used.

To be included in the normal control (NC), participants should score above the cutoff point on neuropsychological tests and not meet the criteria for dementia and personality disorder. Elderly patients who were diagnosed with AD met the criteria for this syndrome according to DSM-V (APA, 2014) and the NIA-AAW (McKhann et al., 2011). For non-organic mental disorders (obsessive compulsive disorder [OCD] and Paraphrenia) criteria were used as described in ICD-10 (WHO, 1992).

Statistical analysis

Descriptive analyses of the variables were: age, education and diagnostic groups; the mean: standard deviation (sd) and percentage. To evaluate the influence of the pentagon drawing test in relation to the diagnostic groups (NC, AD, OCD and Paraphrenia), we used the Kruskal-Wallis test and evaluated the Pentagon test in the group with non organic disorder (OCD and paraphrenia) and with the organic and non-organic groups we used the Mann-Whitney test. We also used the ROC curve analysis to establish cutoff points according to the diagnosis groups.

Results

Sample corresponded to 22 (34.4%) NC, 14 (21.9%) received a diagnosis of AD; 8 (12.5%) had OCD diagnosis and, 20 (31.3%) were diagnosed with Paraphrenia. The mean age was 75.38 years (sd= 8.10); and 48 (75%) were female. About schooling. It could be noticed that 17 (26.6%) had 1 to 4 years of study; 20 (31.3%) and between 5-8 years of study and more than 8 years was found in 27 (42.2%) subjects (Table 1).

Table 1. Characteristics among the diagnostic groups about age, gender and schooling.
 $p = \text{Kruskal-Wallis}$; * $p = \chi^2$.

	NC	AD	OCD	Paraphrenia	p
Age (years)	72,45 (±9,01)	76,07 (±7,19)	74,38 (±8,93)	78,50 (±6,39)	*0.849
Gender					
Female	81,8%	64,3%	62,5%	80%	0.513
Male	18,2%	35,7%	37,5%	20%	
Schooling					
2 to 4 years	9,1%	0%	25%	65%	0.001
5 to 8 years	40,9%	35,7%	37,5%	15%	
> 8 years	50,0%	64,3%	37,5%	20%	

The analysis of the cognitive tests compared to the diagnostic groups shows statistically significant differences in normal elderly (NC), AD, OCD and Paraphrenia in cognitive instruments, such as MMSE

($p > 0.0001$), CAMCOG ($p > 0.0001$), Pentagon drawing ($p = 0.006$) and Clock Drawing Test by Mendez scale ($p > 0.0001$), as described in Table 2.

Table 2. Mean and standard deviation of the cognitive tests in relation to diagnostic groups.

	NC	AD	OCD	Paraphrenia	p
MMSE	29,23 (±0,87)	20,21 (±6,66)	22,63 (±4,21)	22,80 (±4,86)	0,0001
CAMCOG	97,32 (±6,27)	65,64 (±22,65)	72,13 (±16,94)	76,44 (±15,65)	0,0001
Pentagons	5,91 (±0,29)	4,5 (±1,87)	5,38 (±1,41)	4,56 (±2,06)	0,006
Mendez	19,73 (±0,55)	11,71 (±8,05)	15,88 (±4,64)	16,22 (±5,31)	0,0001

Analyses of ROC (receiver operating characteristic) curves were performed and the results show that the greater Area Under the Curve (Area Under the Curve - AUC) was found in the pentagon drawing for the diagnosis of AD (AUC = 0.756 ; $p = 0.010$), and the sensitivity and specificity, respectively, 100% and 64%.

The results of the ROC curve obtained in OCD group (AUC = 0.585; $p = 0.482$) and Paraphrenia (AUC = 0.716; $p = 0.025$) showed a sensitivity and specificity, respectively, 91% and 75%, 100% and 75% (Graphic 1 and Table 3).

Graphic 1 - Analysis of the ROC curve between diagnostic groups for the Pentagon's drawing, regarding Bourke Scale et al. (1995).

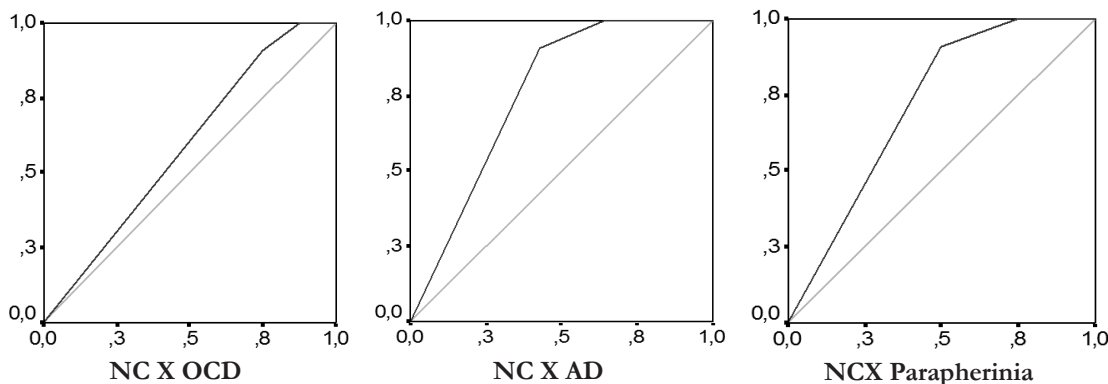


Table 3 – Cutting points created by the methodology of the ROC curve for differentiation between diagnostic groups by Pentagon's drawing, regarding Bourke Scale et al. (1995). Sen. = sensitivity; Spe.= specificity; AUC = área under the curve; p= chi-square.

Groups	AUC	p	Asymptotic 95% Confidence Interval		Sen.	Spe.	Cut-off
			Lower bound	Upper bound			
NC X OCD	0,585	0,482	,337	,482	91%	75%	5 points
NC X AD	0,756	0,010	,578	,010	100%	64%	4 points
NC X Paraphrenia	0,716	0,025	,540	,892	100%	75%	3 points

The cutoff points found by the methodology of ROC curve on the pentagon drawing test (Bourke et al., 1995) was 5 points for the normal controls (NC), 4 points differentiates the elderly with Alzheimer's disease and 3 points for those diagnosed with paraphrenia. A significant difference between the cut-off point was observed between the organic disorder (AD) and the non-organic disorder (Paraphrenia).

Discussion

The Pentagon Drawing Test assesses several cognitive functions (visuospatial and constructional skills, motor skills, verbal comprehension, executive functions and memory) and, despite decades since its creation, there are few data on its effect on the current literature (Fountoulakis *et al.*, 2011). A considerable number of publications address the pentagon design within the MMSE (Folstein, Folstein & McHugh, 1975) analyzing the score objectively, with scores of "0" or "1" point. This form of dichotomous correction limits the analysis capabilities of the instrument, as important details the pentagon drawing test assesses are missing.

A study conducted by Fountoulakis *et al.* (2011) evaluates the predictive capacity of the pentagon drawing in normal patients and those diagnosed with schizophrenia. The authors found six subscales for the pentagon drawing where items such as "Proportion", "Missing Angles", "Quality of Line", "Image Distortion", "Size", "Correction" and "Closing-in", were identified. The subscales showing differences statistically were the items "Proportion", "Missing Angles" and "Quality of Line" that distinguish the normal patients from those with schizophrenia (Fountoulakis *et al.*, 2011).

In this context the aim of this paper was to introduce new data from Pentagon Drawing Test based on the scale proposed by Bourke. It was to this end that Bourke (1995) created the scale with six items for the subject's better assessment. This is an enriching way to evaluate the pentagon test with more details and peculiarities.

In table 1 we verified a significant difference in

the patients with paraphrenia schooling level compared to the other groups. In fact, years of schooling is an important aspect on the elderly cognitive evaluation. Schmidt, Dal-Pizzol, Xavier & Heluany (2009) evaluated elderly separated by education levels in Clock Drawing Test. The authors call the attention to the years of study, i.e., education can be a determining factor in the performance of visuospatial and constructional skills. In our study we used CAMCOG to evaluate constructional apraxia through the pentagon drawing, spiral, house and watched the ideational by putting a paper in an envelope, and ideomotor through the hand movement to say goodbye, with hand cut with scissors and brush your teeth. Paraphrenia group had 20% with schooling over than 8 years. It was the lowest percentage of high schooling. This is one of the limitations of the study because the items of visuospatial constructional apraxia are influenced by education. Hand skills found in some older patients, especially those with less schooling to perform visuospatial and constructional tasks are some limitations of the study. One hypothesis for this would be that many patients despite having attended the primary school (1 to 4 years of study) they never took a pencil in life afterwards. For example, many of our patients come from rural areas, and after finishing primary school, they worked with heavy tasks and never took a pencil again. This becomes biased research because presents changes in design usage which is not present in dementia or paraphrenia, but the lack of manual dexterity to hold a pencil; a tool that is unfamiliar. Comparatively the elderly presented great difficulties when compared with those who write frequently.

It is known that the frontal lobe is an area responsible for the personality make-up and the consciousness. An operation of this brain area mainly causes behavioral changes such as planning and analysis of the consequences of their own actions (Bertolucci, 2012; Damasio et al., 1993; Sadock et al., 2007). In OCT dysfunction of the frontal lobe the patient's attention focuses on a particular element and can not be distracted conditioning the motor execution rituals (Caldas, 1999; Venkatasubramanian et al., 2009). In patients with

schizophrenia frontal lobe dysfunction causes behavioral change, worse cognition especially in working memory and executive functions (Convit et al., 2001; Royall et al., 1993).

The frontal area is also responsible for the implementation of cognitive and motor tasks. It can be drawn upon Bertolucci (2012), Damasio et al. (1993), Mesulam (2000) and Sadock et al. (2007). The conceptual ideas that the front region is the connection of cognitive information, motor and responsibility. Accordingly it can be understood that the engagement operation of the frontal lobe (organic and inorganic disease) concurrently affect cognition, motor function and personality.

Pentagon Drawing Test (PDT) analyzes both cognitive and motor function by requiring visual-constructional ability of patients to make the copy of the drawing. In our findings we showed through the

PDT cut points that differentiates organic from non-organic diseases. It is evident the importance of PDT in patients who have cognitive and behavioral change using Bourke' scale peculiarities in pentagon's drawing that MMSE does not describe. It can be assumed that the PDT has a more notorious confluence of information (cognitive and motor) than the other simplified instruments such as the MMSE.

We show the relevance of applying the PDT by the correction of Bourke' scale to present more complete data for the motor function. We believe that the Pentagon Drawing Test is a rich information instrument and that some ways of correcting such as screening tests of subsection have been neglected. We emphasize the importance to apply PDT to differentiate healthy aging cases from those with organic and non-organic diseases.

References

- American Psychiatric Association (2014). *Diagnostic and Statistical Manual of Mental Disorders – DSM-5* (5th ed.). Washington, DC: American Psychiatric Association. doi: <http://dx.doi.org/10.1176/appi.books.9780890425596>.
- Bertolucci, P.H. (2012). Tratamento farmacológico das lesões cerebrais adquiridas. In: Abrisqueta-Gomez J. (Ed.). *Reabilitação neuropsicológica: abordagem interdisciplinar e modelos conceituais na prática clínica*. (p.72-77). Porto Alegre-RS, Artmed.
- Bourke, J., & Castleden, C.M. (1995). A comparison of clock and pentagon drawing in Alzheimer's disease. *International Journal of Geriatric Psychiatry*, 10, 703-5. doi: 10.1002/gps.930100811.
- Convit, A., Wolf, O.T., de Leon, M.J., Patalinjug, M., Kandil, E., Caraos, C., Scherer, A., Saint Louis, L.A., & Cancro, R. (2001). Volumetric analysis of the pre-frontal regions: findings in aging and schizophrenia. *Psychiatry research*, 107(2), 61-73. doi:10.1016/S0925-4927(01)00097-X.
- Cruth, S.J., Rossor, M.N. & Warrington, E.K. (2007). The quantitative assessment of apraxic deficits in Alzheimer's disease. *Cortex*, 43, 976-986. doi:10.1016/S0010-9452(08)70695-6.
- Damasio, A.R. (1993). The frontal lobes. In Heilman K, Valenstein E (Eds.). *Clinical neuropsychology*. (p. 410-449). 3.Ed. New York: Oxford Univ Press.
- Folstein, M.F., Folstein, S.E., & McHugh, P.R. (1975). "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *Journal of psychiatric research*, 12(3), 189-98. doi: [http://dx.doi.org/10.1016/0022-3956\(75\)90026-6](http://dx.doi.org/10.1016/0022-3956(75)90026-6).
- Fountoulakis, K.N., Siamouli, M., Panagiotidis, P.T., Magjira, S., Kantartzis, S., Terzoglou, V.A., & Oral, T. (2011). The standardised copy of pentagons test. *Annals of general psychiatry*, 10(1), 13. doi: 10.1186/1744-859X-10-13.
- Giannakopoulos I, P, Duc, M., & Gold, G. (1998). Pathologic Correlates of Apraxia in Alzheimer Disease. *Archives of Neurology*, 55, 689-695. doi:10.1001/archneur.55.5.689.
- Gupta, M., Bassett, E., Iftene, F., & Bowie, C.R. (2012). Functional outcomes in schizophrenia: understanding the competence-performance discrepancy. *Journal of psychiatric research*, 46(2), 205-11. doi: 10.1016/j.jpsychires.2011.09.002.
- Lynne, A.R.A. (2006). Semantic knowledge in mild cognitive impairment and mild Alzheimer's disease. *Cortex*, 42, 675-684. doi:10.1016/S0010-9452(08)70404-0.
- Martinelli, J.E., Cecato, J.F., Montiel, J.M., & Bartholomeu, D. (2013). Avaliação e intervenção em um caso de esquizofrenia de início tardio: relato de caso. *Revista de Ciências Médicas e Biológicas*, 12(2), 247-50.
- McKhann, G.M., Knopman, D.S., Chertkow, H., Hyman, B.T., Jack, C.R.Jr., Kawas, C.H., Klunk, W.E., Koroshetz, W.J., Manly, J.J., Mayeux, R., Mohs, R.C., Morris, J.C., Rossor, M.N., Scheltens, P., Carrillo, M.C., Thies, B., Weintraub, S. & Phelps, C.H. (2011). The diagnosis of dementia due to Alzheimer's disease: recommendations from the National Institute on Aging-Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. *Alzheimer's & dementia: the journal of the Alzheimer's Association*, 7(3), 263-9. doi: 10.1016/j.jalz.2011.03.005.
- Mesulam, M.M. (2000). *Principles of behavioral and cognitive neurology*. UK: Oxford University Press.
- Pfeffer, R.I., Kurosaki, T.T., Harrah, C.H.Jr., Chance, J.M. & Filos, S. (1982). Measurement of functional activities in older adults in the community. *Journal of gerontology*, 37, 323-329. doi: 10.1093/geronj/37.3.323.

- Roth, M., Tym, E., Mountjoy, C.Q., Huppert, F.A., Hendrie, H., Verma, S. & Goddard, R. (1986) CAMDEX. A standardised instrument for the diagnosis of mental disorder in the elderly with special reference to the early detection of dementia. *The British journal of psychiatry: the journal of mental science*, 149, 698-709. doi: 10.1192/bjp.149.6.698.
- Royall, D.R., Mahurin, R.K., True, J.E., Anderson, B., Brock, I.P., Freeburger, L., Miller, A. (1993). Executive impairment among the functionally dependent: comparisons between schizophrenic and elderly subjects. *The American journal of psychiatry*, 150(12), 1813-9. <http://dx.doi.org/10.1176/ajp.150.12.1813>.
- Sadock, B.J., & Sadock, V.A. (2007). O cérebro e o comportamento. In Sadock BJ, Sadock VA (Ed). *Compêndio de psiquiatria*. (p.83-159), 9ª ed. Porto Alegre, Artmed.
- Schmidt, J.A., Dal-Pizzol, F., Xavier, F.M.F., & Heluany, C.C.V. (2009). Aplicação do teste do desenho do relógio em octogenários e nonagenários participantes de estudo realizado em Siderópolis/SC. *Psico-USF*, 40(4), 525-530.
- Strub, R. & Black, F.W. (2000). *The Mental Status Examination in Neurology*. (4th Ed). Philadelphia, PA, FA Davis. doi:10.1001/archneur.1978.00500280072019.
- Venkatasubramanian, G., Rao, N.P., Behere, R.V. (2009). Neuroanatomical, neurochemical, and neurodevelopmental basis of obsessive-compulsive symptoms in schizophrenia. *Indian journal of psychological medicine*, 31(1), 3-10. doi: 10.4103/0253-7176.53308.
- World Health Organization (1992). *Mental disorders classification and ICD-10 behavior*.
- Yesavage, J.A., Brink, T.L., Rose, T.L., Lum, O., Huang, V., Adey, M. & Leirer, V.O. (1983). Development and validation of a geriatric depression screening scale: a preliminary report. *Journal of psychiatric research*, 17 (1), 37-49. doi: 10.1016/0022-3956(82)90033-4.

Fecha de Recepción: 17-02-2016

Fecha de aceptación: 16-08-2016