Journal of Neurology, Neurosurgery, and Psychiatry 1987;**50**:1312–1317

A comparative evaluation of the short orientation memory concentration test of cognitive impairment

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SUMMARY In order to assess the relative sensitivity and specificity of Katzman's short orientation memory concentration test (OMCT), 89 non demented patients and 44 patients affected by vascular or degenerative dementia were consecutively evaluated by three different mental status tests. The OMCT appeared equivalent to the Mini Mental State Examination in identifying dementia. Optimum sensitivity and specificity, respectively 88% and 94%, were achieved by a 10/11 cut-off score, giving a 11% false positive rate. Among patients with Alzheimer's disease, the OMCT score was correlated with mean values of a simple reaction time. It was also correlated with the Wechsler global MQ and the orientation, logical memory and paired associates items of the scale. There was no relationship between the OMCT score and the coloured Progressive Matrices IQ. The OMCT was reliable when given at 1 month interval. Serial evaluations did not show any significant practice effect.

Designing adequate instruments for testing mental functions is a task of the utmost importance in the field of clinical research on dementia. In 1983, Katzman *et al*[1] described the Short Orientation Memory Concentration Test (OMCT), a six item version of Blessed's Mental Status Test,[2] both of which had been found to correlate well with pathological findings in the brain of demented patients. The advantage of the OMCT is its brevity and high face validity. To our knowledge, there are no published sensitivity or specificity standards for this test. In order to know if the OMCT is more specific or sensitive than other widely used mental status tests, we studied comparatively the OMCT, the Mental Status Questionnaire (MSQ)[3] and the Mini Mental State Examination (MMSE)[4] in a population of demented and non demented patients. In the group of demented patients concurrent validity and test-retest reliability of the OMCT were evaluated in patients affected by senile dementia of Alzheimer type (SDAT).

Patients and methods

The subjects were 133 patients referred to the department of Neurology. They ranged in age from 37 to 94 years. There were 58 males and 75 females, subdivided in four subgroups according to their diagnostic category. The controls were 23 subjects (8 male, 15 female, mean age 75·9 years, range 50–91) living in the community and referred for functional disorders. They were free of psychotropic or antidepressant drugs. There was no evidence of stroke or other CNS disease from history and detailed neurological examination.

The neurological sample were 33 subjects (17 male, 16 female, mean age 64·5 years, range 37–91) with diagnosis established in the department of Neurology.

Diagnoses included Parkinson's disease without cognitive impairment (9), transient ischaemic attacks (7), transient global amnesia (3), traumatic sequellae (3), transient cerebral anoxia after cardiac arrest (3), epilepsy (2), other neurological diseases (6). The patients were treated according to their clinical condition but free of neuroleptics or antidepressant drugs.

The psychiatric sample were 33 subjects (15 male, 18 female, mean age 56·5 years, range 30–77) referred from psychiatric departments in our hospital or outside. Clinical diagnoses were established by experienced psychiatrists according to the DSM III criteria.[5] They were major depressive disorder (11), schizophrenia (9), other psychotic disorders (2), personality disorder due to alcohol abuse (7), delirium (2), neurotic disorders (1), no DSM III condition (1). All the patients were estimated by psychiatrists to be free of cognitive impairment and none of them had a clouded state of consciousness or poor cooperation during the tests. Eighteen of 33 patients received neuroleptics for at least one week.

The demented patients were 44 subjects (18 male, 26 female, mean age 73·9 years, range 60–94) defined according to DSM III criteria. They were 35 patients affected by senile

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Received 3 April 1986 and in final revised form 13 December 1986. Accepted 23 December 1986

Table 1 *Mean scores of OMCT, MSQ and MMSE in the different diagnostic categories*

Diagnosis	*N*	*M/F*	*Age (yr)*	*OMCT*	*MSQ*	*MMSE*
Control	23	8/15	75·9 ± 10·7 [50–91]	3·9 ± 3·1 [0–10]	9·7 ± 0·4 [9–10]	27·2 ± 1·7 [24–30]
Neurological disease	33	17/16	64·5 ± 13·2 [37–91]	2·6 ± 2 [0–8]	9·8 ± 0·3 [9–10]	27·5 ± 1·8 [24–30]
Psychiatric disease	33	15/18	56·5 ± 12·7 [30–77]	5·6 ± 4·1† [0–15]	9·3 ± 1·3 [5–10]	26 ± 3·1 [16–30]
Dementia	44	18/26	73·9 ± 8·7 [60–94]	19 ± 7·1* [2–28]	5·5 ± 2·6* [1–10]	14·6 ± 6·2* [1–28]

Values are means ± SD. Ranges are indicated in brackets.
*$p < 0.001$ compared with three other groups, †$p < 0.02$ compared with neurological disease.

dementia of the Alzheimer type (SDAT) who met NINCDS criteria for a clinical diagnosis of probable Alzheimer's disease,[6] three patients with multi infarct dementia, one with Pick's disease, one with progressive supranuclear palsy (PSP) and four with mixed or unspecified dementia. All the patients but five were free of neuroleptics or antidepressant drugs. Standard biological parameters, EEG and CT scan were available for all demented patients. In sum, there were 89 patients free of cognitive impairment (40 male, 49 female, mean age 64·4 years, range 37–91) and 44 demented patients of comparable educational level.

In the present study, the three tests MMSE, MSQ and OMCT were administered consecutively in the same order by the same physician during the same session. Items common to the three tests or two of them were asked only once. Normal score (no impairment) is respectively 0, 10 and 30 for OMCT, MSQ and MMSE. Most impairment is scored 28, 0 and 0, respectively.

In the sample of demented patients, a subset of 21 SDAT patients was extracted for concurrent validity and test-retest reliability. Concurrent validity was further determined by correlating OMCT score with reaction time, Wechsler Memory Scale and Raven PM 47 Progressive Matrices. The simple reaction time was performed in the same session as the OMCT according to a procedure previously described.[7] The Wechsler Memory Scale and PM 47 were evaluated by a trained psychologist blind to the OMCT scores and performed during the same week. Test-retest reliability studied by a single examiner was assessed by giving the OMCT twice at 1 month interval. Nine clinically stable SDAT patients had serial evaluations during 6 to 21 months.

Results

(1) *Detection of cognitive impairment*

In the sample of control and neurological patients ($N = 55$), no patient scored less than 24 on the MMSE or 9 on the MSQ and more than 10 on the OMCT. In the sample of psychiatric patients, the range of scores was larger, from 16 to 30 on the MMSE, 5 to 10 on the MSQ and 0 to 15 on the OMCT. Nevertheless, 27/33 (82%) of the psychiatric patients and 11/11 (100%) of those affected by major depressive disorders scored in the limits observed in control and neurological patients. The lowest values were obtained in two patients with chronic psychosis and two with personality disorder due to alcohol abuse but only one of them scored less than 20 on MMSE and over 13 on OMCT. In the dementia group, all the SDAT and MID patients but three scored 22 or less on the MMSE and 11 or more on the OMCT. Two SDAT patients scored 10 on the MSQ. The others scored 9 or less. The two patients with Pick's disease and PSP had normal scores on the three tests.

The mean scores for each test in each diagnostic category are indicated in table 1. The OMCT was highly correlated with the MSQ and MMSE scores (respectively $r = -0.896$. $p < 0.001$ and $r = -0.926$, $p < 0.001$). One way analysis of variance (ANOVA) across the four groups of patients for each of the three tests showed significant differences ($F = 58.9$ df $= 3$, 129 $p < 0.001$, $F = 89.4$ $p < 0.001$, $F 93.9$ $p < 0.001$ for MSQ, MMSE and OMCT, respectively). The OMCT discriminated among demented and normal subjects, as did the MMSE and MSQ. Among the three tests, the OMCT was the only one to discriminate significantly psychiatric from neurological patients for mild cognitive impairment ($t = 2.50$,

Table 2 *Variations of mean scores of OMCT, MSQ and MMSE as a function of age in control patients*

Age group	*N*	*Age (yr)*	*OMCT*	*MSQ*	*MMSE*
<80	12	68·1 ± 9·2 [50–79]	2·8 ± 2·4 [0–8]	9·9 ± 0·2 [9–10]	28 ± 1·3 [25–30]
⩾80	11	84·3 ± 3 [80–91]	5·1 ± 3·3 [0–10]	9·6 ± 0·5 [9–10]	26·3 ± 1·8 [24–30]

Values are means ± SD. Ranges indicated in brackets.

Table 3 *Sensitivity and specificity of OMCT, MSQ and MMSE according to cut-off scores as defined in the literature*

		SDAT *N*	*Not demented* *N*	*Total* *N*	*Sensitivity* *%*	*Specificity* *%*	*False positive* *%*	*False negative* *%*
		44	*89*	*133*				
OMCT	28–11	39 (a)	5 (b)	44				
Score	10–0	5 (c)	84 (d)	89	88	94	11	5
MSQ	0–7	32 (a)	2 (b)	34				
Score	8–10	12 (c)	87 (d)	99	72	97	5	12
MMSE	0–20	36 (a)	2 (b)	38				
Score	21–30	8 (c)	87 (d)	95	81	97	5	8

For each test: Sensitivity is the percentage of demented patients with an abnormal score (a/a + c), Specificity is the percentage of not demented patients with a normal score (d/b + d), False positive indicates the percentage of abnormal scores found in non demented (b/a + b), False negative indicates the percentage of normal scores found in demented patients (c/c + d).

Table 4 *Sensitivity and specificity of the MMSE, MSQ and OMCT according to the raw scores of each test. n indicates the number of patients with a given score in the group of demented (total 44) and non demented (total 89). Sensitivity 100n/N. Specificity 100(1–n/N)*

	Dementia present *N = 44*		*Dementia absent* *N = 89*	
MMSE	*n*	*Sensitivity* *%*	*n*	*Specificity* *%*
MMSE Score				
0–15	24	54·5	0	100
0–16	30	68·1	1	98·9
0–17	31	70·4	1	98·9
0–18	32	72·7	1	98·9
0–19	34	77·2	1	98.9
0–20	36	81·8	2	97·8
0–21	39	88·6	3	96·7
0–22	41	93·1	4	95·6
0–23	41	93·1	5	94·4
0–24	42	95·4	11	87·7
0–25	42	95·4	23	74·2
0–26	42	95·4	32	64·1
0–27	42	95·4	49	45
0–28	44	100	60	32·6
0–29	44	100	81	9
0–30	44	100	89	0
MSQ score				
0–3	12	27·2	0	100
0–4	18	40·9	0	100
0–5	24	54·5	2	97·8
0–6	29	65·9	2	97·8
0–7	32	72·7	2	97·8
0–8	35	79·5	7	92·2
0–9	40	90·9	17	80·9
0–10	44	100	89	0
OMCT score				
28–16	31	70·4	0	100
28–15	32	72·7	1	98·9
28–14	32	72·7	1	98·9
28–13	34	77·2	3	96·7
28–12	37	84	4	95·6
28–11	39	88·6	5	94·4
28–10	39	88·6	8	91·1
28–9	39	88·6	8	91·1
28–8	41	93·1	16	82·1
28–7	42	95·4	16	82·1
28–6	42	95·4	29	67·5
28–5	42	95·4	31	65·2
28–4	43	97·7	47	48
28–3	43	97·7	47	48
28–2	44	100	73	18
28–0	44	100	89	0

df = 64, $p < 0{\cdot}02$). When psychiatric patients were compared with controls, the difference was not significant. This is probably in relation to the difference of age between the two groups. In fact, a greater proportion of control individuals aged 80 years and over had worse scores on the three tests (table 2) The difference between OMCT scores in psychiatric patients and controls aged less than 80 was significant at 0·01 level ($t = 2{\cdot}82$, df = 43).

No significant difference was observed on the scores of the three tests between patients treated by neuroleptics and patients free of this treatment.

(2) *Relative sensitivity and specificity*

To compare the sensitivity and specificity of the three tests, we first used cut-off points according to the literature.[1 4 8] They were respectively 10, 8, 21 for OMCT, MSQ and MMSE scores. These values are consistent with regression lines calculated from our sample (OMCT versus MMSE: $y = -0{\cdot}758x + 29{\cdot}71$, OMCT versus MSQ: $y = -0{\cdot}270x + 10{\cdot}71$). It is shown (table 3) that the OMCT identified correctly 88% of demented patients versus 72% for MSQ and 81% for MMSE. In contrast, the MSQ and MMSE identified correctly 97% of the subjects without dementia versus 94% for the OMCT. These differences are not significant (chi square).

According to the defined cut-off points, false positive results were slightly more frequent with OMCT (11%) than with MSQ and MMSE (5%). We subsequently calculated sensitivity and specificity (table 4) for the different values of the OMCT, MSQ and MMSE scores. It is shown that a higher range of sensitivity of the OMCT is obtained for a score lower than 8 but that specificity is lower (82%) for such a cut-off score. The comparison of the curves shows that the best ratio of sensitivity/specificity is obtained at the cut-off score 10/11. This is equivalent to a cut-off score of 22/23 on the MMSE in our sample.

Table 5 *Pearson correlation for Wechsler Memory Scale subtests and OMCT score in a group of 21 SDAT patients*

	r	p
Information	−0·837	<0·001
Orientation	−0·541	<0·02
Mental control	−0·390	NS
Logical memory	−0·482	<0·05
Digit span	−0·333	NS
Drawings	−0·394	NS
Paired associates	−0·554	<0·01
MQ	−0·562	<0·01

(3) *Concurrent validity and reliability in SDAT patients*

Twenty one SDAT patients free of neuroleptics were tested by a simple reaction time during the same session as the mental status evaluation. There was a significant correlation between the mean reaction time and the OMCT score (Pearson $r = 0{\cdot}457$, $p < 0{\cdot}05$).

A trained psychologist blind to the OMCT evaluation administered the Wechsler Memory Scale (WMS) and the Progressive Matrices (Raven PM47) to 21 SDAT patients during the same week as the mental status evaluation. There was a significant relationship between the MQ and the OMCT scores (Pearson $r = -0{\cdot}562$, $p < 0{\cdot}01$ and Spearman $r_s = 0{\cdot}590$, $p < 0{\cdot}01$). When the OMCT scores were correlated with each item of the WMS, it appeared that the best correlations were in relation with general information ($r = -0{\cdot}837$, $p < 0{\cdot}001$), orientation ($r = -0{\cdot}541$, $p < 0{\cdot}02$), logical memory ($r = -0{\cdot}482$, $p < 0{\cdot}05$) and paired associates ($r = -0{\cdot}554$, $p < 0{\cdot}01$). The OMCT score was not correlated with the digit span or the drawings items of the WMS (table 5). There was no relationship between the Raven PM47 IQ and the OMCT score (Spearman $r_s = 0{\cdot}09$).

When the OMCT score was given twice 1 month apart in 18 clinically stable SDAT patients by the same tester, the correlation was highly significant (Pearson $r = 0{\cdot}829$, $df = 16$, $p < 0{\cdot}001$). Wilcoxon T was not significant ($N = 12$, $T = 28$) and the practice effect was nil.

A 6 to 21 months follow-up was available in nine SDAT patients. The OMCT was given serially every 2 or 3 months and the scores appeared stable. (table 6). No significant difference was found between the first and the last evaluations compared by a Wilcoxon matched pairs signed rank test ($N = 6$, $T = 9$).

Discussion

As predicted by Katzman *et al*,[1] patients clinically classified as having no cognitive impairment scored 10 or less on OMCT in the control and neurological groups, irrespective of their age. Nevertheless, the patients older than 80 scored significantly less than the younger patients. Comparatively, the MMSE and MSQ scores were respectively 24 or more and 9 or more. These results are similar to those obtained in the literature using the MMSE in elderly retired residents[4 9] and in neurological patients.[10]

In the group of demented patients, 39/42 (92%) scored 11 or more on the OMCT and 22 or less on the MMSE. It is noticeable that the two patients with frontal dementia had normal scores on the three tests, suggesting that the OMCT is not useful in screening for this type of dementia. These two patients fit the DSM III criteria for dementia since they had a loss of intellectual abilities which interfered with social functioning, impaired judgment and personality change. The patient with progressive supranuclear palsy showed disorders of language and graphic perseverations. Both patients showed a decrease in overall intellectual functioning with impaired verbal and performance WAIS subtests, impaired Benton's visual retention test form C (PSP patient, university professor: VIQ = 104, PIQ = 98, Benton 4/7. Pick patient, technician: VIQ = 97, PIQ = 88, Benton 5/6). Both had a significant frontal atrophy on CT scan. Both have been followed serially during more

Table 6 *Individual OMCT scores in 9 SDAT patients during a 6 to 21 months follow-up*

Patient No	*Age (yr) Sex*	*Serial OMCT Scores*											
1	67F	28	25	28								28	
2	68M			28	28	28	28			28		28	
3	65M	20	20	18	20	24	25	20		22		25	
4	72M							21	18		18	22	
5	65M							28	25		28	28	
6	69F							25	23		25	28	
7	58F						14	16	24		26	22	
8	67M						12	10		13	8	10	
9	77M							19			14	17	
		1	3	5	7	9	11	13	15	17	19	21	Months

than 2 years. The patient with PSP died within 3 years after she had completed the syndrome with complete ophthalmoplegia and axial rigidity. Her last evaluation by the three tests in November 1985, 6 months before death, showed scores within normal range (4, 10 and 26 on OMCT, MSQ and MMSE respectively). The patient with Pick's disease is still at home but needs permanent care. His last evaluation in May 1986 showed a slight but not significant decline (4, 9 and 25 on OMCT, MSQ and MMSE respectively).

Using the standard cut-off point 10/11 per normality,[1] the OMCT showed a slightly but not significantly higher sensitivity and lower specificity compared with the MSQ and MMSE in dementia identification. Optimum specificity and sensitivity were achieved by this cut-off score. Comparatively, the optimum values with the MMSE were 23 or less, giving the respective percentage of 94% and 93%. These values are higher than those obtained in the literature with MMSE by previous authors.[10 11] It is noticeable that the ratio of false positive and negative results is also lower than in other studies. These discrepancies could be related to the sampling of patients which included delirious patients[11] and focal hemispheric lesion[10] in other studies. Thus, in the present study, the OMCT appeared useful and sensitive in identifying cognitive impairment.

The validity of OMCT in SDAT was concurrently assessed in comparison with simple reaction time and standardised psychometric evaluations. Reaction time is a reliable index of central nervous system impairment and SDAT patients perform significantly worse than normal controls.[12] We have previously reported such results using a simple reaction time task.[7] In the present study, there was a significant relationship between the OMCT score and the mean RT value. Since the most impaired patients are unable to perform the RT, it is likely that the correlation observed with the OMCT is an indicator of predictive validity.

The Wechsler Memory Scale and the Raven PM47 Progressive Matrices are valuable tests for the evaluation of memory disturbances and visual perception impairment in patients with SDAT.[13] As it could be predicted, the OMCT scores of SDAT patients were correlated with the information, orientation and memory items of the WMS but not with the digit span and drawing subtests.

The absence of correlation with mental control was unexpected since it is included in the OMCT in a similar form. Conversely the good correlation with paired associates learning is an indication of the value of the OMCT in revealing impairment of verbal learning.

The OMCT score was not correlated with the PM47 IQ, showing that the test is not useful in differentiating patients with visual perception impairment. This is in relation with the absence of visuo-spatial item in the OMCT. A similar result was shown by Dick *et al*[10] using the MMSE who found the test to be relatively insensitive to damage of the right hemisphere.

The test-retest reliability by a single examiner showed a high correlation at 1 month interval and no difference between the two evaluations using the Wilcoxon matched pairs signed rank test. Nevertheless, in relation to the weighted score of the OMCT, it is likely that the reliability by different observers is lower than with the MMSE or MSQ. When clinically stable patients were studied serially over 6 to 21 months, the scores appeared stable. Nevertheless, the group is too small for statistical analysis and three patients scored the maximum range at the beginning of evaluation.

We could not test the usefulness of the OMCT in distinguishing between organic dementia and pseudo-dementia of depression since no patient was referred with the latter condition. It is likely that the OMCT is not specific in this respect.

In conclusion, while OMCT is not of aetiological value, it is useful in screening for dementia. It appears highly sensitive and specific at levels similar to the MMSE. Its value in identifying mild cognitive impairment in psychiatric patients and dementia at the onset is probably worth emphasising. Further studies are required to know if the test is specific for distinction between true dementia and pseudo-dementia of depression.

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Since the submission of this manuscript, we have become aware of a similar work by LJ Thal *et al*, comparing the Blessed Information-Memory Concentration Test and the Mini Mental State Exam in Alzheimer's disease (*Neurology*, 1986;**36**:262–4).