

Memory and Social Behavior Changes Before and After Electroconvulsive Therapy in Patients with Major Depression and Schizophrenia

Seham Rashed, Hoda Salama and Maha El-Tayebani

Electroconvulsive therapy (ECT) was reported to have faster and more sustained rate of improvement of major depression and schizophrenia when compared to drug therapy. It may affect the cognitive functions and / or behavior. This study was conducted to assess the memory and social behavioral changes in patients with major depression and schizophrenia receiving ECT. Twenty one patients with major depression and 23 with schizophrenia, were selected. Memory tests and social behavioral evaluation were done. The results showed no significant differences in memory functions and social behavior after both unilateral and bilateral ECT in both group of patients, except for significant improvement of immediate memory (digit span), visual motor performance (copy part of Bender Gestalt) and psychomotor retardation in schizophrenic group. The trail making test became worse after bilateral ECT than after unilateral ECT in schizophrenics but not in major depressive patients with no significant difference. Also patients who received more ECT courses during their life showed lower scores on digit span than those who did not. Duration of generalized convulsions was positively correlated with improvement in patients' activities.

(Egypt.J. Psychiat., 1999, 22: 219 - 229).

INTRODUCTION

Convulsive therapy as a treatment for mental illness must be credited to the Hungarian psychiatrist Ladislas Meduna who recognized the therapeutic effect of generalized seizures. In January 1934, he used intramuscular injection of Camphor oil in a catatonic patient who had a seizure 15 or 20 minutes after the injection. The patient recovered and a new therapeutic era in psychiatry began (Fink, 1984; Kalinowsky, 1982). Although convulsive therapy was first

conducted for the treatment of schizophrenia, clinical experience soon showed that it was much more effective for depressive illness, Melancholia in particular, and affective disorders in general, and gives better and quicker results than antidepressant drugs with a response rate of 80-95% (Kerry, 1996; Rummans, 1993).

The cognitive effects of ECT critically depend on how soon patients are studied after the treatment. Several technical factors influence the time to recovery of orientation following and ECT induced seizure : unilateral or bilateral placement, type of stimulus wave form, the number and spacing of treatments, and the electrical stimulus intensity relative to seizure threshold (Sackeim, 1994).

Memory deficits after ECT include:
(a) Retrograde and anterograde amnesia, both components diminish in severity

Siham Rashed, Professor of Psychiatry, in Psychiatric Unit, Faculty of Medicine, Alexandria University.

Hoda Salama, Assistant Professor of Psychiatry, in Psychiatric Unit, Faculty of Medicine, Alexandria University.

Maha El-Tayebani, Assistant Lecturer in Psychiatry Alexandria, University.

over a period of few weeks after the completion of the ECT course, and was not detectable 6 months later (Kaplan, 1994) (b) Verbal memory impairment associated with right unilateral ECT is considerably less than that associated with bilateral ECT. (c) Non-verbal memory depends on the integrity of the right temporal lobe, so it is affected by right unilateral ECT more than verbal material. (d) Right unilateral ECT has considerably less effect than bilateral ECT on remote memory (Squire, 1986).

Most studies indicate that low-energy brief pulse ECT is followed by less amnesia than high energy sinusoidal ECT (Kaplan, 1994).

The objective of this work was to study the memory and the social behavioral changes before and after ECT in major depressives and in schizophrenics.

SUBJECTS AND METHODS:

The study was conducted on 44 inpatients receiving ECT in the Psychiatry Unit of Alexandria University Hospital in the period from September to November 1995.

DSMIV criteria for schizophrenia or major depression was done.

A. Twenty one patients with major depression were subdivided into:

1. Eleven patients received unilateral ECT.
2. Ten patients received bilateral ECT.

B. Twenty three patients with schizophrenia were subdivided into:

1. Thirteen patients received unilateral ECT
2. Ten patients received bilateral ECT.

ECT course was of 8 sessions. All

patients were examined 1-3 days before starting the ECT course, and were re-examined 7 days after completion of the course.

I. Clinical examination :

A. Physical examinations to exclude any physical illness affecting memory.

B. Psychiatric interview.

II . Psychometric tests:

A. Cognitive testing :

a. Digit span from WAIS (Wechsler, 1966).

b. Bender Gestalt visual motor test (Soueif, 1961).

c. Trail making test (Soueif, 1971).

B. Social behavioral evaluation (guided by items from):

a. Hamilton depression scale (Janet, 1988).

b. The social behavior schedule (Wykes, 1986).

c. Ward daily behavior scale (Blunden, 1994).

ECT procedure:

ECT was administered three times per week at 8 O'clock in the morning. Patients were asked to stop all medication 2 days before receiving ECT. Immediately before anaesthesia an anticholinergic agent (Atropine sulphate, 0.6 mg) was given IV then thiopental sodium (Intraval) was given in a dose of 4-6 mg/kg body weight diluted in 20 ml saline. Unilateral ECT was given on the non-dominant hemisphere. Stimulation was done using Duopulse model 2 CA-432 apparatus, constant current, Ectron LTD (made in England). During every session the period of generalized motor seizure was measured by a stop watch from the onset of the tonic contraction till cessation of all motor activity. A mean was then calculated for total duration of all seizure activity during the course.

Data Analysis :

Chi square and t, paired t tests were used to compare the results. The level of significance was taken at 0.05.

RESULTS

Age : Twenty one major depressive patients (13 females and 8 males) had a mean age of 37.62 ± 14.43 years, eleven of them received unilateral ECT and ten received bilateral ECT.

B. Twenty three schizophrenic patients (11 females and 12 males) had a mean age 27.74 ± 7.6 years, 13 of them received unilateral ECT and 10 received bilateral ECT.

The mean age of onset for major depressive patients was 30.38 ± 4.11 years while it was 24.40 ± 6.29 years for schizophrenics.

Marital status:

Eleven (52.3%) major depressives were married compared to 15 (65.2%) schizophrenics were single.

Education and Work:

Nine (42.86%) major depressives had primary and preparatory school education, while 13 (56.52%) schizophrenics were not working.

Clinical Presentation:

Table (1): shows that suicidal thoughts or attempts presented the main indication of ECT among major depressives (52.38%), while psychomotor retardation in schizophrenics was the main indication (47.8%).

The mean total duration of generalized motor seizures among depressive patients was 210.45 ± 51.54 seconds for unilateral ECT and 205.00 ± 46.56 seconds for bilateral ECT, $t=1.183$ (not significant). Among schizophrenics it was 244.38 ± 27.64 sec for unilateral ECT,

while it was 230.90 ± 27.82 sec. for bilateral ECT with no significant differences ($t=0.47$).

Psychometric tests and social behavioral evaluation:**A. Major depressive patients :**

Patients in this group showed improvement in the mean scores in all memory tests after the course of 8 unilateral ECT than before its use, this improvement was only significant in the mean score of copy part of Bender Gestalt test ($t=2.49$). After course of 8 bilateral ECT, the improvement (all the mean scores of memory tests) was not significant than before its use.

On comparing the mean scores' differences of memory tests after using unilateral and bilateral ECT; there was no significant differences between the two methods ($t=0.38$ for digit span, 0.131 & 0.58 for copy and recall parts of Bender Gestalt and 0.22, 0.21 for Part A & B of trail making test) (Table II).

A significant improvement in all mean scores of behaviors on the social behavior scale after using a course of unilateral ECT was found except for hostility. After bilateral ECT course all mean scores of social behavior scale items were significantly improved. No significant differences between the mean scores of social behavior in the major depressives after unilateral or bilateral ECT courses (Table III).

B. Schizophrenic Patients

The mean scores of memory tests before and after unilateral ECT course of therapy revealed no significant improvement. While after bilateral ECT course there was significant improvement in the mean scores of digit span ($t=4.04$), copy part of Bender Gestalt test ($t = 3.96$) and part (A) of the trail making test ($t=2.73$).

The comparison of the mean scores differences of the memory test after uni-

Table 1
 Number of Previous Depressive Attacks, Duration of the Present Depressive
 Attack, Duration of Schizophrenic Illness, and Indication of ECT in Both Groups

		Major depression		Schizophrenia	
		N	%	N	%
Number of previous depressive attacks per life	- No previous attacks	1	4.76	-	-
	- One attack	7	33.33	-	-
	- 2-10 attacks	9	42.86	-	-
	- > 10 attacks	4	19.05	-	-
Duration of the recent depressive attack	Less than 4 months	18	81.57	-	-
	4-6 months	3	14.29	-	-
Duration of schizophrenia	Less than 1 year	-	-	4	17.39
	< 10 years	-	-	17	73.91
	< 20 years	-	-	2	8.69
Previous ECT courses	No	14	66.67	16	69.56
	Yes (1-3 courses)	7	33.33	7	30.43
Indication of ECT	1. Stupor	1	4.76	1	4.35
	2. Suicide	11	52.38	3	13.04
	3. Severe psychomotor retardation with refusal of food	1	4.76	11	47.83
	4. Agitation	5	23.81	-	-
	5. Excitement	-	-	4	17.39
	6. Pregnancy	-	-	1	4.35
	7. Refractory to medical treatment	3	14.29	1	4.35
	8. Rapid development of extrapyramidal manifestations with neuroleptics	-	-	2	8.69

Table 2
Memory Tests Before and After ECT Courses (8 Sessions Each) In Major Depressives

Memory tests	Unilateral ECT				Bilateral ECT				T Difference between mean difference
	Before	After	Mean difference	T	Before	After	Mean difference	T	
Digit span of WAIS	7.00±2.91	8.20±3.52	-1.20±3.084	-1.23	4.56±4.59	6.33±3.08	-1.78±3.59	-1.48	0.38
Fender Gestalt test									
- Copy	18.50±6.36	19.9±6.03	-1.40±1.776	-2.49*	17.11±4.86	18.11±4.01	-1.00±3.71	-0.81	0.31
- Recall	14.60±7.93	16.8±7.71	-2.20±4.104	-1.70	8.89±7.39	12.44±5.89	-3.56±6.02	-1.77	0.58
Trail Making test									
- Part (A)	129.50±78.33	130.3±83.57	-0.80±13.855	-0.18	112.50±60.88	111.25±25.87	1.25±25.87	0.14	0.22
- Part (B)	176.0±94.89	169.0±94.54	7.00±25.949	0.85	173.13±60.12	173.75±46.58	4.38±27.96	0.44	0.21

Table 3
Social Behaviours Before and After ECT Courses (8 sessions) in Major Depressives

Items of social behaviour	Unilateral ECT				Bilateral ECT				T Difference between mean difference
	Before	After	Mean difference	T	Before	After	Mean difference	T	
1. Suicide	3.00±1.14	0.18±0.41	2.818±1.328	7.04***	1.90±1.29	0.10±0.32	1.80±1.23	4.63***	1.82
2. Work and activities	2.73±1.19	0.82±0.75	1.636±1.433	3.79**	3.20±0.79	0.90±0.74	2.30±0.82	8.83***	1.28
3. Psychomotor retardation	1.73±1.19	0.09±0.30	1.636±1.120	4.82**	1.10±0.99	0.20±0.42	0.90±0.74	3.86**	1.07
4. agitation	1.00±1.17	0.00±0.00	.00±1.265	2.62*	2.00±1.33	0.10±0.32	1.90±1.19	5.02***	1.07
5. Personal appearance and hygiene	1.73±1.10	0.45±0.93	1.273±0.786	5.37***	1.80±0.63	0.40±0.69	1.40±0.84	5.25***	0.26
6. Incoherence of speech	-	-	-	-	-	-	-	-	-
7. Laughing & talking to self	0.73±1.10	0.09±0.30	0.636±1.027	2.46	0.00±0.00	0.00±0.00	0.90±1.10	2.59*	0.57
8. Hostility	1.18±0.1	0.09±0.30	.09±0.302	12.04***	0.30±0.48	0.30±0.48	0.80±0.42	6.00***	1.83
9. Eating & drinking	1.09±0.12	0.00±0.00	.09±0.302	12.04***	0.30±0.48	0.30±0.48	1.10±0.316	11.00***	0.07
10. Sleep									

Table 4
Memory Tests Before and After ECT Courses (8 sessions each) in Schizophrenics

Memory tests	Unilateral ECT				Bilateral ECT				T Difference between mean difference
	Before	After	Mean difference	T	Before	After	Mean difference	T	
Digit span of WAIS	7.46±4.19	6.77±3.27	0.69±3.83	0.75	2.11±2.4	5.00±3.00	-2.89±2.15	-4.04*	2.84*
Bender Gestalt test									
- Copy	19.15±6.59	18.38±5.06	0.77±3.86	0.78	12.56±4.85	1*.98±*.37	-4.33±3.28	-3.9**	3.41*
- Recall	12.69±6.93	13.15±6.91	-0.6±4.11	0.39	4.89±4.78	6.66±6.16	-1.78±2.95	-1.	0.79
Trail Making test									
- Part (A)	101.15±69.59	73.10±67.6	3.85±30.90	0.45	127.50±42.68	103.50±*2.91	24.0±24.89	2.7*	1.56
- Part (B)	162.69±76.23	173.08±67.3	-10.8±31.98	1.17	198.57±64.92	18*.71±*7.91	17.86±41.42	1.14	1.70

Table 5
Social Behaviours Before and After ECT Courses (8 sessions) in Schizophrenics

Items of social behaviour	Unilateral ECT				Bilateral ECT				T Difference between mean difference
	Before	After	Mean difference	T	Before	After	Mean difference	T	
1. Suicide	1.31±1.8	0.2±0.44	1.08±1.55	2.50*	0.80±1.69	0.00±0.00	0.80±1.09	1.50	0.41
2. Work and activities	0.92±0.6	1.40±0.88	1.85±0.80	8.31***	3.80±0.42	1.70±0.82	2.10±0.74	9.00***	0.78
3. Psychomotor retardation	0.92±1.18	0.54±1.19	0.54±1.19	1.6	2.20±1.23	0.30±0.48	1.90±1.10	5.46***	2.79*
4. agitation	-	-	-	-	-	-	-	-	-
5. Personal appearance and hygiene	3.23±1.01	1.23±1.01	1.23±1.01	4.38***	3.60±0.52	1.90±0.88	1.70±0.82	6.53***	1.19
6. Incoherence of speech	2.23±1.01	1.54±0.66	1.54±0.66	8.40***	2.90±1.19	1.40±0.84	1.50±0.97	4.88***	0.11
7. Laughing & talking to self	2.23±1.09	1.69±0.95	1.69±0.95	6.44***	3.20±0.63	1.20±0.92	2.00±0.94	6.71***	0.77
8. Hostility	2.77±1.30	2.54±1.19	2.54±1.19	6.31***	1.40±1.35	0.20±0.42	1.20±1.23	3.09*	1.73
9. Eating & drinking	0.83±0.3	0.54±0.66	0.54±0.66	2.94*	1.80±0.42	0.80±0.42	1.00±0.6	4.74***	1.66
10. Sleep	1.15±0.38	0.77±0.44	0.77±0.44	6.32***	1.20±0.42	0.50±0.53	0.70±0.78	4.58***	0.36

Table 6
Correlations of Memory Tests and Social Behaviour Scores after ECT
Courses to the age of onset, number of Previous depressive attack, number of Previous ECT
Courses and Duration of Generalized Convulsions During ECT in Major Depressives (n = 21)

	Age of onset		No. of Previous attacks/life		No. of previous ECT courses/life		Duration of generalized seizures (Sec)	
	R	P	R	P	R	P	R	P
Memory tests								
Digit span (WAIS)	-0.335	0.069	-0.126	0.294	-0.544	0.005*	0.349	0.060
Bender Gestalt visual motor test								
Copy	-0.092	0.345	0.269	0.119	-0.106	0.34	-0.026	0.455
Recall	-0.247	0.140	0.143	0.268	-0.291	0.101	0.045	0.424
Trail Making test:								
Part A	-0.163	0.251	-0.222	0.180	0.49	0.2*1	-0.002	0.497
Part B	-0.001	0.499	-0.187	0.222	0.49	0.2*1	0.023	0.464
Social behaviour								
1. Suicide	-0.108	0.321	0.076	0.372	0.00	0.5*0	0.137	0.276
2. Work and activities	-0.088	0.351	0.036	0.438	-0.285	0.1*5	-0.387	0.041*
3. Psychomotor retardation	0.043	0.351	0.036	0.372	0.00	0.5*0	-0.017	0.471
4. Agitation	0.165	0.426	0.076	0.393	0.16	0.0*1	-0.19	0.193
5. Personal appearance and hygiene	-0.103	0.328	-0.063	0.338	-0.255	0.1*2	0.031	0.447
6. Incoherence of speech	-	-	-	-	-	-	-	-
7. Laughing & talking to self	-	-	-	-	-	-	-	-
8. Hostility	-0.233	0.155	0.007	0.489	-0.158	0.2*7	0.095	0.341
9. Eating & drinking	0.141	0.271	0.087	0.420	0.71	0.2*9	0.211	0.180
10. Sleep	0.376	0.047	0.036	0.438	0.49	0.4*6	-0.1*0	0.272

*Significant

Table 7
Correlations of Memory tests and Social Behaviour After ECT Course to age of Onset
Duration of illness, Number of Previous ECT's Duration of Generalized Seizures, In Schizophrenics (n=23)

	Age of onset		Duration of illness		No. of previous ECT courses/life		Duration of generalized seizures (Sec)	
	R	P	R	P	R	P	R	P
Memory tests								
Digit span (WAIS)	-0.313	0.073	-0.133	0.272	-0.313	0.03	-0.286	0.093
Bender Gestalt visual motor test								
Copy	-0.298	0.08	-0.187	0.195	-0.277	0.10	-0.22	0.178
Recall	-0.193	0.188	-0.142	0.260	-0.103	0.13	0.022	0.460
Trail Making test:								
Part A	0.221	0.155	0.228	0.147	0.109	0.30	0.256	0.119
Part B	0.178	0.208	0.207	0.172	0.34	0.42	0.255	0.120
Social behaviour								
1. Suicide	0.077	0.363	-0.149	0.249	-0.097	0.30	0.309	0.077
2. Work and activities	0.1*32	0.228	0.345	0.054	-0.439	0.019*	-0.356	0.048*
3. Psychomotor retardation	0.0708	0.37	0.192	0.190	-0.040	0.48	0.189	0.193
4. Agitation	-	-	-	-	-	-	-	-
5. Personal appearance and hygiene	-0.318	0.069	-0.009	0.483	0.37	0.19	-0.356	0.048*
6. Incoherence of speech	0.285	0.093	0.312	0.074	-0.479	0.010*	0.255	0.120
7. Laughing & talking to self	0.349	0.051	0.214	0.163	-0.419	0.023*	0.094	0.335
8. Hostility	-0.028	0.448	0.127	0.282	-0.012	0.48	-0.115	0.301
9. Eating & drinking	0.316	0.071	0.056	0.399	0.08	0.17	-0.31	0.082
10. Sleep	-0.144	0.257	-0.113	0.304	-0.062	0.39	-0.076	0.366

*Significant

lateral and bilateral ECT courses in schizophrenic patients revealed a significant improvement after bilateral ECT course in the mean scores of digit span test ($t = 2.84$) and the copy part of Bender Gestalt test ($t = 3.41$) (Table IV).

All behaviors on the social behavior scale improved significantly after unilateral ECT course in schizophrenics except for the psychomotor retardation. After bilateral ECT course the improvement was significant among all mean scores of behaviors except for mean score of suicide.

Comparison of the mean scores differences on social behavior scale after unilateral or bilateral ECT courses showed only a significant improvement for psychomotor retardation after 8 bilateral ECT course ($t = 2.79$) (Table V).

Correlative studies.

Major depressive patients (Table VI):

There was a significant negative correlation between the number of previous ECT courses / life and the scores on digit span ($r = 0.5544$ and $P = 0.005$).

Another significant negative correlation was found between the mean duration of generalized seizures and the scores of work and activities ($r = 0.387$ and $P = 0.041$).

Schizophrenic Patients : (Table VII):

A significant negative correlations was found between the number of previous ECT courses in life and the scores of work and activities ($r = 0.436$, $P = 0.019$), the score of incoherence of speech ($r = 0.479$ and $P = 0.01$) and the score of laughing and talking to self ($r = 0.49$, $P = 0.023$).

Negative correlation was found between the duration of generalized convulsions and the score of work and activities ($r = 0.356$, $P = 0.048$).

DISCUSSION

Depressed Patients :

The present study revealed improvement in immediate memory (Digit span of WAIS), visual motor performance (Bender Gestalt test) and in performance on the trail making test after both unilateral and bilateral ECT courses (non-significant differences between the two methods). This improvement of the cognitive functioning may be explained by the remission of the affective symptoms. This agrees with the study of Stoudermire et al (1995) who observed the cognitive changes in 8 elderly depressed patients whose pretreatment cognitive impairment resolved after ECT. On the contrary Calev et al (1991) found no performance changes pre-to post ECT on digit span however they did find a significantly reduced level of performance post ECT on the paired-associate learning test. Gass et al., 1986; Kopleman, 1986 found no association between depression and digit span performance. Steif et al (1986) found that both immediate and delayed memory functions were significantly impaired, they suggested that immediate memory performance is more sensitive than the delayed and that ECT has more persistent effects on the retention of information than on information acquisition. In the study of Squire & Slater (1983) there was a permanent loss of at least some memories formed during a period of several months before and after treatment, that memory completes usually refers to the failure to recover memories around the time of treatment rather than impairment of recent memory or incapacity for new learning, and there is no basis for supposing that ECT causes permanent loss of memory function. Another conclusion was reported by Frith et al (1983) that the complaints of long term memory impairment may result from concurrent de-

pression, rather than from long term effects of ECT. Lancaster (1958) who introduced unilateral non-dominant ECT in depressions reported that memory impairment was less severe with this procedure than with bilateral ECT. Such a result can be explained on the ground that verbal functions, including verbal memory are largely subserved by the left hemisphere, while the right hemisphere is implicated in depressed mood state.

Schizophrenic parities:

Bilateral ECT provided significant improvement of immediate memory and visual motor performance. This may be explained by improvement of psychomotor retardation or excitement which interferes with the performance of the test. Furthermore trail making test became worse after bilateral ECT course (i.e. takes longer time) than after unilateral ECT course, but with no significant difference between both methods of treatment.

However memory impairments have been constantly found in schizophrenic patients of all grades of severity, and additional iatrogenic impairment by anticholinergics and dopaminergic antiparkinsonian agents may further compromise already limited functioning in such patients (Baddeley, 1995; Goldberg, 1993; Saykin, 1991).

The present study revealed post ECT behavioral improvement after both unilateral and bilateral ECT courses. The comparison between both methods showed no significant differences except for psychomotor retardation.

Kaplan et al (1994) believed that ECT is an effective treatment for the symptoms of acute schizophrenia and not for chronic schizophrenia, while Kaplan et al (1991) found ECT effective in 5-10% of chronically ill schizophrenics, because it breaks up catatonic posture and excitement.

From the correlation studies of the

presented patients it was found that the immediate retention of patients with major depression receiving much ECT was affected, also there was a better improvement of work and activities in those patients having longer periods of generalized convulsions.

For schizophrenic patients, it was shown that when the number of previous ECT is increased or with longer period of generalized convulsions there was better improvement in patient's activities as well personal appearance and hygiene. Also with increasing the number of ECT sessions the score of incoherence speech and laughing and talking to self decreased.

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Les troubles de la mémoire et du comportement sociale avant et apres les chocs électriques chez les malades de la dépression majeure et du schizohrenie.

L'étude a porté sur 44 patients souffrant de la dépression majeure (21 patients) et du schizohrenie (23 patients) qui ont pris des chocs électriques unilatérale ou bilatérale. Les tests psychométriques ont été faits pour les deux groupes. Les données ont été analysées et 005 était le niveau signifiante. Les résultats ont montré que les deux méthodes de choc électrique améliorent les fonctions de la mémoire et les fonctions du comportement social esans différence statistique et nous avons trouvé une corrélation positive significative entre la durée du choc general et l'amélioration d'activités des patients. Nous affirmons l'importance de l'utilisation des chocs electriques soit unilatérales ou bilatérale dans les différentes maladies psychologiques en déterminant précisément les raisons essentielles pour utiliser cette méthode efficace.

تغيرات الذاكرة والسلوك الإجتماعى قبل وبعد العلاج الكهربائى لمرضى الإكتئاب الجسيم والفصام

تمت دراسة أربعة وأربعين مريضاً قبل وبعد العلاج بالصدمات الكهربائية (ضبط إيقاع المخ) - (٢٣) مريضاً فصامياً أو (٢١) مريضاً بالإكتئاب الجسيم من حيث الذاكرة والأداء الحركى النفسى والسلوك الإجتماعى. أظهرت النتائج تحسن الذاكرة والسلوك الإجتماعى المرضى بعد العلاج سواء بالصدمات أحادية أو ثنائية الجانب (٨ جلسات لكل منهما)، ولم يكن الفارق ذو دلالة إحصائية فى مجموعتى المرضى إلا بالنسبة للتحسن فى إختبار إعادة الأرقام (الذاكرة الفورية) وإختبار بندر جشتلت للأداء البصرى الحركى وكذلك التأخر النفسى الحركى فى مرضى الفصام حيث كان الفارق ذو دلالة إحصائية، وتبين وجود علاقة سلبية بين عدد الجلسات التى أخذت فى العلاجات السابقة وبين درجات إختبار إعادة الأرقام حيث وجد تدهور فى الذاكرة الفورية كما تبين أيضاً وجود علاقة سلبية بين المدة المستغرقة فى التشنجات وبين درجات العمل والنشاطات مما يعنى تحسن المريض فى مجال العمل والنشاطات.