PERSONALITY CHANGES FOLLOWING TEMPORAL LOBECTOMY FOR EPILEPSY

By

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PREVIOUS papers from this hospital have reported clinical, neuropathological and other studies on patients subjected to temporal lobectomy for epilepsy (Falconer, Pond, Meyer and Woolf, 1953; Hill, Falconer and Pampiglione, 1953; Meyer, Falconer and Beck, 1954; Mitchell, Falconer and Hill, 1954; Falconer, Hill, Meyer, Mitchell and Pond, 1955; Meyer and Beck, 1955; Meyer and Yates, 1955; Meyer, 1956). The detailed psychiatric changes following temporal lobectomy are the subject of this paper. Apart from individual case studies and short comments, the effects on personality of temporal lobe ablation have not so far been reported.

The Montreal school who have had most experience with this operation have not studied the mental changes as exhaustively as other aspects, and they also have specifically stated that patients who show gross mental changes have been excluded from operation. Penfield and Flanigin (1950) reported that there was no alteration of behaviour, no particular memory loss and no persistent aphasia following operation, nor was there any defect of initiative or capacity for decision. Paillas *et al.* (1953) report briefly on the personality of four hospitalized cases; only one seems to have benefited from the operation; two others had a bilateral lobectomy without great effect to their disorder, but also without reduction of their intelligence. In agreement with Green *et al.* (1951) they consider overt attacks of rage a contra-indication to surgery. Improvement seemed to occur particularly in children, sometimes with an actual increase in intellectual ability. This is exemplified in the two cases reported by Liddell and Northfield (1954). Green *et al.* (1951) reported that patients with constant hostility benefit from the operation while patients with psychotic or psychopathic trends (including addiction) do not do so. Bailey and Gibbs (1951) considered that in the majority of their 25 cases, operation produced little change in behaviour. They noted that the inverse relationship between grand mal attacks and disturbed behaviour was more prominent after operation, although diminution of the psychomotor attacks following surgery produced less personality disorder than control by medical treatment. In the cases reported by all these authors listed above the excision of the temporal lobe has usually been limited to the lateral and inferior portions of the lobe anterior to Labbé's vein (i.e. the anterior half of the lobe). It has seldom included the deeper portions of the lobe, viz. the uncus, hippocampal gyrus, hippocampus, and amygdala.

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This may explain the differing results on personality reported by these authors and by ourselves.

Plan of Investigation

The majority of the patients in this series were referred initially to the out-patient clinics for epileptics at the Maudsley Hospital. Eight patients, however, came directly from Guy's Hospital to the Neurosurgical Unit. Twenty cases spent several weeks pre-operatively, and a similar or even longer post-operative period under our care in the Maudsley Hospital for intensive psychiatric observation and study. Histories were obtained not only from the patients, but also from relatives so as to obtain as complete a picture as possible not only of the medical events but also of the personality development and the changes therein that seemed related to the present illness. In addition to personality studies special attention was paid to the psychiatric aspects of the actual epileptic attacks—the content of the auras in so far as they appear related to significant features in the past life of the patient; the emotional precipitants of fits and the post-ictal mental changes. All this material was considered at special case conferences together with the results of the special laboratory investigations (EEGs, AEG, etc.), and the decision to operate reached as described in previous reports (Falconer *et al.*, 1955). In most cases the operation included the anterior 6–8 cm. of the temporal lobe including the uncus, hippocampal gyrus, hippocampus, and amygdala, but generally sparing the greater part of the superior temporal gyrus. Following the operation most patients remained in the neurosurgical ward for from 2–3 weeks and were then transferred back to the psychiatric ward for further study and rehabilitation. Subsequently, several patients whose mental condition showed fluctuation of disorder were re-admitted during the earlier part of the post-operative period of from 2–5 years during which this study has been made. The usual reason for such re-admissions was the development of a depressive illness.

Case Material

Twenty-seven cases are considered here, since of the original 31 temporal lobectomy cases reported by our group (Falconer *et al.*, 1955), one suffered an early post-operative death, one was not accessible for follow-up study, one had a bilateral temporal lobectomy performed without improvement and with subsequent death from status epilepticus, and one was too young at the time of operation to have an established personality. Of the remaining 27 patients, all but one showed significant psychological disorder before and/or after temporal lobectomy. In these 27 cases there is an even distribution between the sexes and their ages range from 13 to 56 years. The longest "tumour" history (Case 19) is 22 years, but it will be seen that the duration of the fits is extremely variable. The pre-operative psychiatric status of the group will first be considered.

Pre-operative Psychiatric Status

Six patients had a history of epilepsy and 8 patients of mental disorder in their families. The latter includes only those families in which an individual had had an illness requiring treatment in a mental hospital, treatment at a psychiatric clinic as an out-patient or one who by reason of mental illness has been almost totally ineffectual in life. These figures are high and certainly

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outside the range reported by authors for epilepsy as a whole. The early environment of 16 of the 25 cases in which it was known, was found on enquiry to have been seriously disordered by parental disharmony, quarrelling or desertion. In these cases alcoholism, discord, deprivation of the child of love and care, and separation from parents were most commonly noted. This incidence—16 of 25 cases, is again high for any group of psychiatric patients. Examples of stressful early environment are:

Case 15. The parents of this 25-year-old patient have never been in harmony at any time. Her father has always been a severe alcoholic, who just manages to make ends meet, and when under the influence of alcohol becomes abusive and physically violent. Constant quarrels took place throughout the patient's first 11 years of life, and at the end of that time her mother left to live with another man.

Case 21. A girl aged 22 lost her father before her second year. Her mother was left to fend for her five children in the worst phase of the economic depression, and barely subsisted on the dole and occasional char-ing.

The pre-morbid personality of the patients, that is, the personality before the development of epilepsy could only be assessed in 15 cases since in the remainder the seizures began before the patients were 4 years old. Of these 15, 12 had normal personalities before the onset of fits, as judged from interviews with parents or other relatives. The other 3 patients had well-defined psychiatric disorders—a paranoid state in one (Case 11), fetishism in the second (Case 12) and gross alcoholism in the third patient (Case 29).

Pre-operative Mental State

In only one patient was the pre-operative mental state regarded as normal (Case 16). The abnormalities seen in 26 cases included a range of symptomatology. The great majority showed chronic disorders of personality rather than persistent psychotic reactions. There were 18 cases of *character disorder* (Cases 4, 5, 7, 8, 9, 10, 12, 13, 14, 18, 20, 22, 23, 24, 26, 27, 30, 31), in which are included adults with psychopathic personality, children with primary behaviour disorders and other patients with fundamental disturbances of personality such as schizoid personality, ill-directed and excessive aggressiveness or rudeness or sexual perversion. There were three cases showing symptoms of *hysteria*, one showing serious phobias, the other physical conversion symptoms (Cases 22, 31 and 27). Predominantly *affective* disorder was seen in 2 cases, one with depressive suicidal wishes and self reproach which had previously responded to E.C.T., the other a mild endogenous depression (Cases 15 and 28). A *hallucinatory psychosis* had occurred in two cases, one with schizophrenic features, the other as a brief illness having paranoid character following a group of seizures (Cases 12 and 21). This patient (Case 12) also had a character disorder and has been reported (Mitchell *et al.*, 1954). Predominantly *paranoid states* were found in 5 patients (Cases 6, 11, 19, 25 and 29). This diagnosis was made in a person whose predominant psychiatric disability was the feeling that a part or whole of his environment was against him, who was able to give obviously delusional examples to justify his feeling and who showed resentment at the same time.

Effect of seizures in the pre-operative mental state. It has been held that seizures and the inter-ictal personality disorders have an inverse relationship. Excluding prodromal mental changes, this relationship was observed in 8 of 26 patients in whom this information was available. In 3 of these 8 patients the seizures *sometimes* did not affect the mental state and *sometimes* greatly aggravated the disorder. In the other 13 patients the disorder of personality and the

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occurrence of seizures appeared to be independent of one another. The study of this group of patients therefore does not support the idea of an inverse relationship between seizure incidence and personality disorder. However, in other patients studied by the authors such an inverse relationship has been occasionally found, usually in chronic paranoid psychotic epileptics with bilateral independent EEG spike foci in the temporal lobes.

Post-operative Study

General

The duration of the post-operative study in this group has been from 2 to 5 years. The patients have repeatedly re-attended hospital for clinical, psychometric and EEG study, or have been re-admitted for a few days or a week or two as need arose. Some have been visited in their own homes. Reports of all those concerned with the patient—parents, marital partners, employers, social workers, occupational therapists, nurses, etc., have been obtained.

Apart from common and perhaps specific effects of the operation which will be described, it was important in determining the effects of the operation to assess to what degree the psychiatric disturbances caused disability. For this purpose a rating scale was constructed, comparing the pre-operative and post-operative working abilities, sexuality, general psychiatric symptoms, aggressiveness and need for hospitalization, the highest total score in the scale being 10, the lowest 0. On this rating scale the post-operative scores showed gains (i.e. improvement) in 18 cases, were unchanged in 3 and showed losses in 5 cases. Gains of 10 points were recorded in 2 cases, of 8 points in two cases, and also of 6 points in two cases. Gains of 5, 4 and 3 points were recorded at each level for 3 patients. Two further patients gained 2 points and one patient 1 point. Three patients lost 1 point, one patient 4 points and one 6 points. Five patients were therefore worse on this assessment. All five patients continued to have seizures after operation. On the other hand improvement of scoring on the rating scale was witnessed in a few patients who continued to have occasional seizures post-operatively. However, this rating scale does not do justice to the reality of the improvement in those patients who had been in institutions, sometimes for years, prior to operation. There were 10 such cases. A return to normal life and to employment was witnessed in 6 of these patients.

Specific Changes

The specific changes observed in our patients' personalities, in some in marked degree, in others in much lesser degree, can be grouped under 5 headings. These are (1) changes in intellectual functions, (2) a reduction in aggressiveness, (3) a "turning in" of aggressiveness with a tendency to depressive mood, (4) changes in sexuality, and (5) an increased warmth in social relationships. These will now be considered.

1. *Changes in Intellectual Function.* These have already been reported by our psychologist colleagues, Meyer and Yates (1955). In agreement with previous workers they find no changes in general intellectual ability as measured by tests of I.Q., no change in memory or comprehension, but a specific loss of *learning* ability by auditory means has occurred in some degree, and sometimes in severe degree, in the 19 patients whose operations have been performed upon the dominant hemisphere. In manual workers this is little disability but in the professional classes and in those whose work involves the necessity for retaining information acquired by hearing others speaking, the disability may prove

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crippling. One patient, for example, previously working as a telephonist, was forced post-operatively to abandon this occupation. Another patient, a furniture packer, gave up this occupation because he could not follow verbal instructions.

2. *Reduction in Aggressiveness.* This change, which recalls the "taming" seen in Klüver and Bucy's (1937) monkeys subjected to bilateral temporal lobe ablations, was a prominent feature in 12 patients who previously had been markedly aggressive characters. (Cases 4, 5, 6, 10, 13, 14, 19, 23, 24, 27, 30 and 31.) This "taming" can develop at any time after the operation and may or may not be permanent. This change may be observed by the patient himself or his relatives but was uniformly reported by all those in the hospital who were concerned with the care and rehabilitation of the patients. Relatives noticed that whereas before operation they had to be careful what they said to the patients and how they said it, post-operatively it was possible to talk easily to them without provoking an attack of irritability or impulsive anger. In these patients the tolerance of frustration appears to have increased, and at the same time the patients show insight over their changed reactivity to stressful events.

Examples:

Case 5. This was a 15-year-old girl whose aggression took many violent forms (see Falconer *et al.*, 1953). Immediately after the operation the parents remarked that they could talk with her quite easily without immediately provoking a disturbance in behaviour. This was seen in the first and second post-operative week and the patient herself said that she could remember "upsetting nurses" but no longer had the inclination to do so. Her parents are not well suited to each other and for many years they had expressed their own difficulties by arguing about the patient, and when this path was no longer available their marriage became more disorganized, but they still tended to use the patient as a battle ground.

Case 6. This patient, a 45-year-old man who had been living at home, was noted by his mother to be irrationally irritable at times. After a right temporal lobectomy he has become quite docile in his relationship to her even though his general psychiatric picture has not been noticeably improved.

3. *"Turning-in" of Aggressiveness with Depressive Mood.* In some patients in whom a reduction in outwardly turned aggressiveness was apparent, depressive mood swings, with or without hypochondriasis developed. These occurred in 11 patients (Cases 5, 6, 7, 15, 21, 22, 23, 24, 25, 26, 29 and 31), and in several the depression was so severe that re-admission to hospital became necessary because of incapacity, distress and suicidal risk. E.C.T. was given to 5 patients, (3–4 treatments) and resulted in a rapid recovery in 3 of them. These depressive states tended to recur up to 18 months after operation, had a tendency to spontaneous recovery and when necessary could usually be relieved by E.C.T. Such illnesses were not necessarily related to post-operative fits, which, except in one patient (Case 7), were not a serious issue. These cases are of particular interest from the psychopathological point of view, since during recovery from the depression, a swing over to paranoid hostile attitudes was occasionally witnessed. The relation between inwardly turned aggressiveness and the depressive mental state, and outwardly turned aggressiveness and the hostile paranoid state is apparent in such patients. The post-operative personality changes of the temporal lobectomized patient would seem to create a "model" psychosis susceptible of study because of its short duration, its intensity and its tendency to be altered by therapeutic measures.

Examples:

Case 7. This patient became extremely depressed towards the end of his first post-operative year. Before this he had shown mixed psychoneurotic symptoms. When the depression was

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at its height it manifested itself more in hysterical conversion symptoms and behaviour, but the underlying feeling tone was distinctly that of an affective disorder. He was given electro-convulsive therapy without benefit, and as time went on this depression seemed to resolve itself into a paranoid state which finally required certification. Of the 27 cases his fit pattern was the least "temporal lobe" in character, and his frequent grand mal fits and generalized myoclonic epilepsy remain.

Case 15. This patient had already been in hospital for a depressive illness on several occasions pre-operatively and had been given E.C.T. previously with good but only short term effect. Post-operatively she fluctuated between depression and euphoria, and after a long bout of anorexia caused by cholecystitis she was admitted and again given E.C.T. with the same transient good effect.

Case 22. The pre-operative state of this patient showed an immature hysterical character disorder with swings between over-dramatized depression and elation. Post-operatively she was euphoric, but towards the end of her stay in hospital at the 10th post-operative month she became mildly depressed, and this has continued until the last few months when her affective state has become quite normal, and she is without any hysterical personality disabilities.

Case 25. This patient was mildly paranoid prior to the operation and remained quite unchanged until her discharge in the 8th post-operative week. From that time she became apathetic, seldom spoke, and frequently cried. She stated that she felt hopeless but was unable to give any depressive thought content. Punctuating this chronic state were aggressive out-bursts of a more florid paranoid type when she accused her mother and sister of talking about her in some derogatory way. She was unwilling to enlarge on her ideas of reference. She was admitted in an acutely depressed state 11 months after operation but this fluctuated very rapidly; one day she would be crying, aggressive and paranoid, but the next day she would be agreeable, co-operative and apparently symptom free. The depressive picture predominated and she was given three E.C.T. which coincided with the disappearance of the depressive picture and an increase in the paranoid picture. She became so aggressive that this course of shock treatment was discontinued and by the time of her discharge 3 months later she showed neither depressive nor paranoid symptoms. Her recovery had persisted 5 months later.

Case 26. Electric shock treatment was administered to this patient for a picture that looked entirely depressive but later more paranoid.

Case 31. This patient before right temporal lobectomy showed a hysterical character liable to depression. A short course of E.C.T. brought about a rapid improvement in a severe depressive-hypochondriacal state which had been present after three post-operative weeks of euphoria. In the 9th post-operative month the depression necessitated admission, and a course of 5 electric convulsive treatments resulted in a clearing of the depression and an ability to express pent-up feelings. In the 8 months following her discharge aggressive feelings have disappeared, as has the depression. She appears now to be very much more mature.

4. *Changes in Sexuality.* In 11 patients changes in sexuality could not be assessed because the patients were either pubescent or menopausal. In Case 4 information was not available because of the patient's bland denials when interrogated. Evidence was however available in 16 cases (Cases 7, 8, 9, 10, 11, 12, 15, 18, 19, 21, 23, 24, 25, 26, 29 and 31). In two patients no change could be elicited (Cases 11 and 29). A change in the intensity of libido or in its direction and choice of object was noticed in 14 patients. One patient became impotent, but in general the change experienced was of increased sexual drive and potency. One patient became hypersexual and perverse, masturbating openly in the ward as many as 20 times a day, exhibiting himself to nurses and patients and making homosexual advances. This behaviour ceased when oestrin therapy was exhibited in large doses and did not recur when treatment was discontinued. In three patients (Cases 12, 13 and 24), two of whom have already been reported (Mitchell, Falconer and Hill, 1954; Pond and Bidwell, 1954) a loss of perverse sexual tendencies and a normal libidinal interest and activity occurred. One patient, who pre-operatively had shown sexual promiscuity and infidelity to his wife, developed a normal attitude to marriage.

5. *Increased Warmth in Social Relationships.* A striking change, particularly in the first post-operative months, is the increasing warmth in social

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relations exhibited by this group of patients and detectable even in those, who on total assessment have not been significantly benefited by the operation. This increased warmth, or friendliness, is experienced by the observer as an increase of extroverted attitudes and is associated particularly with the reduced outwardly turned aggressiveness. The patients appear to be more concerned with the attitudes and feelings of others and in this sense can be said to show a lessening of the egotism which was a feature of the pre-operative personality.

In a few cases it has proved impossible to assess whether the personality has undergone improvement, for the change might result in a more acceptable social behaviour but much less acceptable effect on the patient.

Case 23. This patient considers that the operation was a total failure because of its effect on his attitude to work; he placed little value on the improvement which his wife and his doctor have noticed. He has very few fits, is a much more pleasant person to live with, and his work record has not actually suffered.

There are two cases whose personality and whose social adaptation have been affected for the worse by operation (Cases 7 and 26). Reference has been made to Case 7 above. Case 26 was a man who came from a disturbed family environment with a positive family history of epilepsy. He had suffered from temporal lobe epilepsy since the age of 15. The aura of "parasitic word" had undergone a slow change from "diploma" to "pluma" and then to a vague rather pleasurable cephalic rhythm. The fits tended to occur when his wife was menstruating and he had a group of serial grand mal fits after his wife aborted a six-month pregnancy. He had a clear spike focus in the left anterior temporal lobe and a left anterior temporal lobectomy was carried out in January, 1954. He remained three weeks in the Neurosurgical Unit during which time he had one focal fit implicating the left motor cortex. At this time he was noted to be markedly dysphasic when shown 10 fairly simple objects to name. In the 4th post-operative week he was able to name only four of them; he demonstrated the use of three and he would not attempt the remainder. His stay in a psychiatric ward lasted 4½ weeks during which he was constantly requesting our agreement to his discharge. He showed great intolerance to noise of any sort and completely rejected any form of occupational therapy. Following his discharge late in February, 1954, he managed to return to his work as telephonist and to a marriage which had always been unstable. His wife noted that when at home there was a pronounced need to talk, mostly about himself, the treatment or the hospital. He was impossible to "contact" and seemed remote and disinterested in anyone but himself. He was rude and inconsiderate to others which was in marked contrast to his pre-operative personality. The egocentricity has remained unchanged since, although the pressure behind his talk has decreased. Because of his aphasia he was frequently at a loss to name or describe an event or a wish and his demands on his unintelligent wife to fill this gap, to tell him how to spell a word, were very excessive. This, his rudeness, his egocentricity and his impotence shook the already unsteady foundations of the marriage and they have obtained a legal separation. He remains almost fit-free, but is apathetic and because of his inability to learn (he calls it "memory") and his difficulty in speech he has had to be removed from his job as a telephonist. He is at present moderately paranoid in attitude. He says that we did the operation to remove the word "diploma" but failed because he can still remember it; he feels that one of us (W.M.) has implanted the word "insanity" in his mind and when he goes to bed this runs through his mind obsessionally. Each time he is seen he brings up these two points and no amount of explanation alters them. He expresses them with frank hostility.

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Post-operative Fits and Psychological Improvement

At the time of the present study, of the 27 patients, 11 were fit-free, 14 had only occasional seizures and showed great improvement in this respect, one had fewer seizures than before operation, and one was unchanged in this respect by the operation. This patient (Case 7) has already been described and is now a certified patient in a mental hospital. On the rating scale he lost 6 points and from the point of view of psychological change following the operation is the worst result. Another patient (Case 14) has had fewer fits since operation and shows slight psychological improvement, gaining two points on the rating scale. It is clear, however, that within the group of 25 patients who are either fit-free (11 cases) or greatly improved (14 cases), those who become fit-free show more consistent and greater psychological improvement than those who still suffer occasional seizures. The rating scales illustrate this. Of 11 fit-free patients six gained five points or more (one 10 points, two 8 points, one 6 points and two 5 points). Only one patient showed a loss of 1 point (Case 8). This patient died in status epilepticus after being fit-free for 2 years. By contrast, of 14 patients who still suffered occasional seizures only three patients gained 5 points or more on the rating scale (one 10 points, one 6 points and one 5 points). Two patients were unchanged in their scores and three patients showed losses (two of 1 point and one 4 points).

Discussion

The success of the operation of temporal lobectomy for the relief of epileptic seizures may be expected to depend upon the surgeon's ability to remove those brain areas which are the sites of the primary epileptic discharge. This is most likely to occur when the pathological lesion is a discrete one, e.g. tumour or atrophic process confined within the anterior third of one temporal lobe, and where there is no evidence from EEG studies of firing areas outside the anticipated operation site and particularly on the opposite hemisphere. The total disability or incapacity of the patient who is the sufferer from temporal lobe epilepsy is not, however, due only to the occurrence of the seizures. In fact the seizures themselves may become of minor significance as a cause of disability, which is predominantly due to the serious changes of personality that develop. Disturbances of aggressiveness, intolerance of frustration, impulsiveness, changes in sexuality, egotism and mood disorder are then of greater significance than the seizures themselves.

In many patients in whom the personality disorder was severe, there was good evidence from the history and investigations that the patients had suffered *diffuse* brain damage. In these cases the temporal lobe lesions were but a part of the total pathological process. Nevertheless there is still evidence that the temporal lobe disorder itself contributes a significant specific effect upon the psychological functioning of the individual. This was seen particularly in those patients with personality disorder in whom discrete focal lesions were subsequently found in the temporal lobe removed and who subsequently had no further fits and showed a recovery from the personality disorder. The functions which would appear to us to relate most particularly to temporal lobe function are firstly, the ways in which aggressiveness is handled by the patients, secondly in the intensity and direction of libido, and thirdly, in the control over mood stability. Fourthly, there are also the specific functions related to cognitive ability, such as the learning ability.

It is not our purpose here to try and relate these functions to specific parts

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of the temporal lobe. Suffice it to say that lesions of the deeper temporal structures particularly (e.g. uncus, hippocampal gyrus, hippocampus, and amygdaloid nucleus), both experimentally and clinically, may appear to provoke epilepsy on the one hand, and on the other may interfere with the regulating mechanism by which the impulse life of the individual is handled. This is seen in the intensity, direction and fluctuation of the sexual drive and in the expression and control of the aggressive response to frustration—both fundamental activities of the individual which the social conditioning process alters to the ethical demands of the environment. The effects of such lesions are greatest when the lesions occur in a brain still undergoing the processes of growth and maturation, i.e. in young patients, and are greater still when the social environment is disordered and the educational example of the parents itself inadequate. This was seen in the majority of our patients.

Summary

1. A group of 27 patients, subjected to temporal lobectomy for epilepsy, have been studied post-operatively from periods varying from two to five years. The pre-operative and post-operative psychological status have been compared.

2. Pre-operatively 26 of the 27 patients showed some degree of psychological abnormality, which in many was very severe. Post-operatively improvement in some degree, but in some in very marked degree, was found in 18 patients.

3. Changes in learning ability, in aggressiveness, in sexuality and in social relationships are described.

4. The development of depressive illnesses was witnessed during the first post-operative two years in 11 patients.

5. A relationship is found between improvement in psychological status and post-operative freedom from seizures.

6. Assessed on a rating scale the psychological status of five patients was worse than before operation. All five patients continued to suffer epileptic seizures.

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Number	Sex	Age	Duration	Family: Mental	Family: Epileptic	Early Environment	Pre-operative Personality	Mental Hospital	Side of Operation	Pre- and Post-operative Rating Scales: Aggression	Work & School	Sexuality	Psychiatric Symptoms	Hospitalization	Totals: Pre-operative Post-operative	Gains or Losses	Depression Post-op.: Dep.	Depression Post-op.: Ect.	Post-operative Fits	Neuropathological Lesions
4	M	32	30	−	−	Alc.	Character	−	D.	0/2	0/2	? ?	0/1	1/1	1/6	+5	−	−	0	Non-specific changes
5	F	15	7	+	−	Dis.	Character	+	D.	0/2	0/2	−/−	0/2	0/2	0/8	+8	+	−	0	Haemangioma calcificans
6	M	45	43	−	−	Dep.	Paranoid	−	N.D.	0/1	1/2	0/0	1/1	1/1	3/5	+2	+	−	±	Sclerosis of Ammon's Horn
7	M	45	27	+	+	Dis.	Character	+	N.D.	1/0	0/0	2/0	1/0	1/0	6/0	−6	+	+	++	Non-specific changes
8	M	22	20	−	+	—	Character	+	N.D.	0/0	0/0	1/0	0/0	1/1	2/1	−1	−	−	0–+•	Sclerosis of Ammon's Horn
9	M	23	2	−	−	—	Character	−	D.	2/2	1/2	2/1	2/2	2/2	9/9	−	−	−	0	Meningioma
10	M	49	10	−	−	—	Character	−	D.	1/2	1/2	1/2	1/2	2/2	6/10	+4	−	−	±	Non-specific changes
11	F	43	12	−	−	?	Paranoid	−	D.	1/0	1/0	1/1	1/1	1/2	5/4	−1	−	−	±	Capillary angioma
12	M	38	30	−	−	Rej.	Character	−	D.	1/1	2/2	0/2	0/2	1/2	4/9	+5	−	−	0	Non-specific changes
13	M	13	10	?	?	Inst.	Character	+	D.	0/2	0/2	0/2	0/2	0/2	0/10	+10	−	−	0	Sclerosis of Ammon's Horn
14	F	21	19	−	−	Rej.	Character	+	D.	0/1	0/0	−/−	2/2	0/1	2/4	+2	−	−	+	Non-specific changes
15	F	25	14	+	−	Sep.	Depressive	+	D.	0/2	0/0	0/1	0/1	1/1	1/5	+4	+	+	0	Sclerosis of Ammon's Horn
16	M	23	21	−	+	Dis.	Normal	−	N.D.	2/2	2/2	2/2	2/2	2/2	10/10	−	−	−	±	Sclerosis of Ammon's Horn
18	M	47	17	−	−	—	Character	−	N.D.	1/1	0/0	0/1	1/1	1/0	3/3	−	−	−	±	Cicatrix
19	F	40	22	+	−	—	Paranoid	−	D.	0/1	1/2	0/1	0/1	1/2	2/8	+6	−	−	±	Angioma
20	F	48	1	−	−	—	Character	−	D.	−/−	1/1	−/−	−/−	2/2	−/−	−	−	−	±	Small infarct
21	F	22	20	−	−	Pov.	Psychosis	+	D.	1/2	0/2	1/2	0/2	0/2	2/10	+8	+	−	0	Sclerosis of Ammon's Horn
22	F	16	7	−	+	—	Character	+	D.	1/2	0/2	1/1	1/2	0/2	3/9	+6	+	−	0	Sclerosis of Ammon's Horn
23	M	36	34	−	−	Sep.	Character	−	N.D.	1/1	2/2	1/2	1/1	1/1	6/7	+1	+	+	±	Sclerosis of Ammon's Horn
24	F	23	22	+	−	—	Character	+	D.	0/2	0/2	0/2	0/2	0/2	0/10	+10	+	−	±	Sclerosis of Ammon's Horn
25	F	20	6	+	+	Alc.	Paranoid	−	D.	1/1	0/2	0/1	0/1	1/1	2/6	+4	+	+	±	Sclerosis of Ammon's Horn
26	M	32	15	−	+	Alc.	Character	−	D.	1/0	2/1	2/1	1/0	1/1	7/3	−4	+	+	±	Non-specific changes
27	F	45	42	+	−	Dis.	Character	−	D.	0/1	2/2	−/−	0/1	1/2	3/6	+3	−	−	0	Non-specific changes
28	M	56	6	−	−	Alc.	Depressive	−	D.	1/2	0/2	−/−	1/2	1/2	3/8	+5	−	−	±	Oligodendroglioma
29	M	42	4	−	−	?	Paranoid	+	D.	1/1	0/1	1/0	1/0	1/1	4/3	−1	+	−	±	Non-specific changes
30	F	51	11	−	−	—	Character	−	N.D.	1/2	1/2	1/1	1/2	2/2	6/9	+3	−	−	0	Oligodendroglioma
31	F	27	12	+	−	Dis.	Character	−	N.D.	1/2	1/2	1/2	1/2	2/1	6/9	+3	+	+	±	Sclerosis of Ammon's Horn

Early Environment:
Alc. = alcoholic parent.
Dis. = parental discord.
Dep. = maternal deprivation.
Rej. = maternal rejection.
Inst. = institutional upbringing.
Sep. = parents separated.
Pov. = poverty.

Pre-operative Personality:
Character = character disorder.
Paranoid = paranoid psychosis

Side of Operation:
D. = dominant hemisphere.
N.D. = non-dominant hemisphere.

Post-operative Fits:
0 = fit free.
± = occasional fits, great improvement.
+ = less than pre-operatively.
++ = unchanged or worse.
• = fit free 2 years then died in status.

Rating Scale: (10 total maximum).

Aggressiveness:
0 = notoriously frequent outbursts.
1 = occasional tractable outbursts.
2 = no outbursts.

Working Ability:
0 = no work or very little.
1 = part-time work.
2 = full work.

Sexuality:
0 = perverse.
1 = impotent, frigid.
2 = normal.

General Psychiatric Symptoms:
0 = significant symptoms in complaint.
1 = symptoms present but not prominent.
2 = no symptoms.

Hospitalization:
0 = frequent admissions or continued stay.
1 = occasional and brief admission.
2 = none.

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