
The history of stereotactic psychosurgery in Finland

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Abstract

Human stereotactic neurosurgery was developed in the late 1940s in the hope of replacing the then popular lobotomy with a more accurate and less harmful psychosurgical procedure. This article examines the history of stereotactic psychosurgery in Finland, being the first study on the history of stereotactic psychosurgery in which all the operations in one country have been covered using primary sources such as patient records and operation diaries. In Finland, around 140 patients underwent a stereotactic psychosurgical operation (for example, a capsulotomy, a cingulotomy, or a mesoloviotomy) between the late 1960s and late 1990s, some of them more than once. The most common diagnoses of the patients were neuroses and schizophrenia, and the patients usually suffered from aggressiveness, anxiety, depression, obsessive-compulsive symptoms, phobias, restlessness or tension. The medical professionals evaluating the results of the operations often regarded the patients as having improved.

Introduction

Psychosurgery, the use of neurosurgery for mental disorders, has a colourful and controversial history, including the 1949 Nobel Prize in Physiology or Medicine awarded to Portuguese neurologist Egas Moniz, the developer of lobotomy (1). From its peak in the 1940s and 1950s, resorting to psychosurgery declined mainly because of new psychotropic drugs (2, 3).

Human stereotactic neurosurgery was developed in the late 1940s in the United States in the hope of replacing the then popular lobotomy with a more accurate and less harmful psychosurgical procedure (4, 5). Stereotactic neurosurgery makes use of a stereotactic instrument with which an electrode, for example, can be placed to the desired location in the brain (6). With this kind of surgery, the neurosurgeon can reach any part of

the brain with a precision of less than half a millimetre (7). The inventors of human stereotactic neurosurgery were Ernest A. Spiegel, a neurologist and neurophysiologist, and Henry T. Wycis, a neurosurgeon (4), who performed the first stereotactic operation in 1947. Although the first operation was not psychosurgical, the pair began psychosurgical operations during the same year (8).

After Spiegel and Wycis, other neurosurgeons around the world, such as Lars Leksell in Sweden, Jean Talairach in France, and Hirotaro Narabayashi in Japan, started to perform stereotactic operations on psychiatric patients (9). In Finland, stereotactic psychosurgical operations were performed by Lauri Laitinen, one of the second-generation pioneers of stereotactic and functional neurosurgery, in the Department of Neurosurgery of Helsinki University Central Hospital (hereafter the Department of Neurosurgery) from 1967 to 1975. In addition to psychiatric patients, Laitinen operated stereotactically on patients suffering, for example, from different kinds of pain conditions, epilepsy, and parkinsonism (10). Laitinen began to practice stereotactic neurosurgery in the early 1960s as the first neurosurgeon in Finland (9). By comparison, in Sweden, the practice had begun in the late 1940s and in Denmark and Norway in the late 1950s (11-13).

This article examines the use of stereotactic psychosurgery in Finland, relying on the patient records and operation diaries of the Department of Neurosurgery as well as on articles and conference papers by Lauri Laitinen and his co-workers. Helsinki University Central Hospital was the only hospital in Finland, a country of four and a half million people, where stereotactic psychosurgery was in use on a large scale. In Oulu University Central Hospital, a few psychiatric patients were operated on between the early 1980s and late 1990s for obsessive-compulsive disorder (14).¹ The number is very small compared to the 135 psychiatric patients operated on in Helsinki (10).

This article addresses the following questions: What procedures were used to perform stereotactic psychosurgery in Finland? What kinds of patients were operated on? What were the main indications for the operations? What were the results of the operations?

¹ According to the operation diaries of the Department of Neurosurgery of Oulu University Central Hospital, the first patient was operated on in 1983 and the last in 1997 (15). The operation diaries from January 1987 to June 1994 were not available, so Esa Heikkinen is referred to.

In addressing the questions, a qualitative interpretation of the sources is accompanied by a quantitative statistical analysis that gives an overall picture of all the psychiatric patients operated on with stereotactic neurosurgery. This is the first study on the history of stereotactic psychosurgery in which all the operations in one country have been covered using primary sources such as patient records and operation diaries. This article does not include stereotactic deep brain stimulation (DBS) operations for psychiatric disorders, which have as yet only been performed in Finland on two patients in Helsinki and four in Tampere (16).

From capsulotomy to capsulotomy

The interest in psychosurgery resurfaced among neurosurgeons in the late 1960s and early 1970s as a result of increased knowledge of the anatomy and function of the brain and the precision offered by stereotactic neurosurgery (17, 18). This is reflected in the fact that the first international congress on psychosurgery was held in 1948, whereas the following congresses were held in 1970, 1972, 1975, and 1978 (19). Psychiatrists had realized by the late 1960s that not all psychiatric patients responded to psychotropic drugs (20). There was a demand for psychosurgery once again, although for a much smaller, more specific patient population (21).

In Finland, the first psychiatric patient to undergo a stereotactic operation was referred to the Department of Neurosurgery from a small mental hospital called Paihola Hospital in 1967 (10, 22). The patient, who had been diagnosed with schizophrenia, was a 22-year-old woman, and the referring doctor wanted to have her lobotomized. Gunnar af Björkesten, Professor of Neurosurgery, wrote to Paihola that lobotomies were rarely performed in the Department of Neurosurgery, but added that "of course, there are still cases where this operation is indicated".² The patient was not, however, lobotomized in the customary way as Lauri Laitinen decided that because the patient was so young and her intelligence so well preserved, he would perform a less radical stereotactic operation instead. In the patient records, Laitinen referred to the procedure he used as stereotactic lobotomy (22), but, to be exact, he used capsulotomy (23), a procedure that Jean Talairach had introduced in the late 1940s (24, 25).

² In this article, all the quotations from the patient records are translated from Finnish by the author.

As can be seen from Table 1, Laitinen used almost all the major stereotactic psychosurgical procedures, of which (anterior) capsulotomy, (anterior) cingulotomy, and innominotomy, which corresponds to subcaudate tractotomy, have still been in regular use. The procedures were all based on interrupting connections between the frontal lobe and limbic structures (26). For example, in a cingulotomy, lesions are made in the cingulum in order to disconnect Papez's proposed circuit of emotion³ (26, 27). Sometimes Laitinen combined procedures and performed, for example, a cingulotomy and a mesoloviotomy during one operation (22).

According to Elliot S. Valenstein, with few exceptions, neurosurgeons performing psychosurgery used the same procedure on all of their patients. The selection of the procedure was based on the neurosurgeon's preferences rather than the patient's symptoms (18). Laitinen was one of the exceptions in that he did not operate on all of his patients using the same procedure, but did he base the selection of the procedure on the patient's symptoms? In December 1969, he performed a cingulotomy on a patient who had been diagnosed with schizophrenia. The patient wanted to kill himself, which is why he was referred from Paihola Hospital to the Department of Neurosurgery for a psychosurgical operation. Before the operation, Laitinen wrote in a letter to Paihola that he had systematically been making lesions in different locations and would later evaluate which location delivers the most positive results (22). Before 1970, Laitinen had performed 4 capsulotomies and 11 cingulotomies (Table 1). Those patients he operated on using capsulotomy had similar symptoms to the patients he operated on using cingulotomy, anxiety being one of the main symptoms in both the capsulotomy patients and the cingulotomy patients (22). At first, Laitinen searched for the best procedure, using different procedures for the same symptoms. For a couple of years, cingulotomy was his procedure of choice (Table 1).

By 1972, Laitinen had begun to base the selection of the psychosurgical procedure on the patient's symptoms.⁴ For example, he usually performed amygdalotomies on aggressive and restless mentally retarded patients. In 1970, he had performed a hypothalamotomy on a man with sexual neurosis after having performed a cingulotomy on

³ James W. Papez hypothesized in 1937 that emotional stimuli passed, via the cingulum (in the cingulate gyrus), from the septum to the hippocampus and then, via the fornix, to the hypothalamus (mammillary bodies), from the hypothalamus to anterior thalamic nuclei, and from thalamic radiations back to the cingulate gyrus (27, 28).

⁴ An important factor for Laitinen to begin to base the selection of the psychosurgical procedure on the patient's symptoms may have been the Second International Conference on Psychosurgery held in Copenhagen in August 1970. Laitinen and Juhani Vilkki wrote on the offerings of the conference in an article published in November 1970 (29). In 1971, Laitinen's repertoire of procedures widened (Table 1).

him without much success and having learned that Fritz Roeder, a German neurosurgeon, had operated on similar patients with positive results (22).⁵ In 1972, Laitinen began to use capsulotomy again (Table 1). The first patient he operated on using capsulotomy after 1968 was a man suffering from obsessive-compulsive neurosis upon whom he had performed a mesoloviotomy a month earlier with no effect. Before the second operation, Laitinen described the selection of the procedure and stated that, according to contemporary knowledge, capsulotomy seemed to have the best effect on obsessive, neurotic behaviour (22). The patient records show that Laitinen now wanted to discover the most appropriate procedures for different symptoms.

Table 1. Stereotactic procedures and operations on psychiatric patients in the Department of Neurosurgery (includes reoperations).										
Procedure	1967	1968	1969	1970	1971	1972	1973	1974	1975	Total
Amygdalotomy	-	-	-	-	13	1	-	-	-	14
Capsulotomy	1	3	-	-	-	7	10	8	5	34
Cingulotomy	-	-	11	17	23	-	5	1	1	58
Hypothalamotomy	-	-	-	1	1	-	5	1	-	8
Innominotomy	-	-	-	-	3	-	1	6	1	11
Mesoloviotomy	-	-	-	-	11	19	7	2	-	39
Amygdalotomy + innominotomy	-	-	-	-	-	-	1	-	-	1
Capsulotomy + mesoloviotomy	-	-	-	-	-	2	-	-	-	2
Cingulotomy + mesoloviotomy	-	-	-	-	3	7	4	1	1	16
Total	1	3	11	18	54	36	33	19	8	183

From December 1973 to May 1974, Timo Kuurne performed 10 operations as first operator. According to Kuurne, he was Laitinen's assistant. Timo Kuurne, Emeritus Neurosurgeon, 2011, personal communication.

⁵ Laitinen most likely learned about Roeder's operations from Roeder's 1969 article to which he referred in an article he wrote with Juhani Vilkki (29, 30).

Laitinen not only relied on the procedures other neurosurgeons had devised but also devised his own procedure, namely mesoloviotomy. In a mesoloviotomy, lesions were made in the knee of the corpus callosum. Laitinen had discovered during one cingulotomy operation that electrical stimulation of the knee of the corpus callosum "resulted in a sudden strong feeling of inner well-being and relaxation of the whole body of the patient - a 24-year-old woman with anxiety and obsessions of schizophrenic origin", which encouraged him to make bilateral lesions in the corpus callosum (31, 32). At first, he called the procedure callosotomy but changed the name to mesoloviotomy because the former "mixes Latin and Greek" and the corpus callosum is mesolovion in Greek (31). Laitinen was apparently the only neurosurgeon in the Nordic countries who devised his own psychosurgical procedure.

In 1973, Laitinen presented a paper at the Fifth International Congress of Neurological Surgery in Tokyo, concluding on the selection of the psychosurgical procedure. He recommended: capsulotomy for neurotic anxiety, obsessive-compulsive symptoms and phobias; cingulotomy for chronic pain with addiction and manic-depressive illness; innominotomy for aggressive behaviour and depression; mesoloviotomy for schizophrenic anxiety, catatonia and tension; and posterior hypothalamotomy for restless and violent behaviour (33). The recommendations were based on literature and on the operations Laitinen himself had performed for different symptoms. Sometimes, when he was not sure a particular procedure would alleviate certain symptoms, Laitinen performed experimental operations, as in the case of one patient on whom he performed a mesoloviotomy (and later a capsulotomy) because of a long-lasting neurosis with anxiety and phobias. The patient returned to the department half a year after the operation, which had not sufficiently improved his condition. In the patient records, Laitinen noted that he had earlier performed "an experimental mesoloviotomy" on the patient and was now going to propose a capsulotomy for him (22).

Apparently, experimentation was necessary for evaluating what kinds of cases a particular psychosurgical procedure would prove effective. When Laitinen reported on his new procedure, mesoloviotomy, in *The Lancet*, he wrote about 14 patients upon whom he had performed the operation. Eleven patients had suffered from "intractable anxiety, fears, and tension of neurotic, schizophrenic, or epileptic origin" and 3 from "involutional melancholia" (a form of depression that occurs in late middle age, sometimes accompanied by paranoia). In the latter patients, "the immediate clinical result seemed to be nil" (31). Those patients were clearly operated on in order to experiment whether mesoloviotomy would prove effective in involutional melancholia. Based on the operations performed on the patients with melancholia, Laitinen

concluded: "Anxiety and depression do not respond to the same drug; and it now seems that neuroanatomically these symptoms are also separated". He then suggested that, "One surgical approach to depression is a stereotactic lesion in the substantia innominata of the supraorbital area" (innominotomy) (31).

According to Valenstein, evaluation of the effects of psychosurgical procedures was problematic because objective criteria and proper experimental controls were lacking (34). Laitinen also recognized the subjectivity of evaluation. At the Fifth International Congress of Neurological Surgery, he stated that the lack of experimental controls had made assessments "more or less subjective" (32, 33).

Patients and indications

In 1970, there were 18 mental health districts in Finland. Each district had a central mental hospital and usually one or more hospitals for chronic patients. There were also a couple of state hospitals mostly for criminal patients and university psychiatric clinics in Helsinki, Oulu and Turku. In 1970, the largest hospitals were Nikkilä Hospital in Sipoo (923 beds) and Törnävä Hospital in Seinäjoki (785 beds) (35). However, the size of the hospital did not directly correlate with the number of referred psychosurgery patients. More patients were referred for psychosurgery to the Department of Neurosurgery from the small Paihola Hospital (269 beds in 1970) than from Nikkilä, Törnävä, or any other hospital (22). This can be explained by the chief physician's belief in psychosurgery. Matti Apo, Chief Physician of Paihola Hospital, had written positively on lobotomy in the late 1960s (20), when lobotomies were rarely performed in Finland anymore (36), and continued to believe in psychosurgery into the 1980s, stating that "psychosurgery may be useful in selected cases with severe psychiatric disease" (37).

The mean age of the patients referred for psychosurgery to the Department of Neurosurgery was 33 years for men and 38 years for women (Table 2). Age was not a contraindication for psychosurgery: the youngest patient who underwent an operation was a 7-year-old boy, whereas the oldest patient was a 69-year-old woman. Eight of the operated on patients were children (less than 18 years old) (10, 22). The patient records reveal that seven of the eight children had been diagnosed as having mental retardation with aggressive behaviour. All seven were referred from Vaalijala Central Institution for the Mentally Retarded and were operated on using amygdalotomy. Before the first operation on a patient from Vaalijala, the referring doctor consulted

Laitinen regarding a lobotomy. Laitinen, however, suggested an amygdalotomy, stating that, with amygdalotomy, "the patient can be freed from aggressiveness and asocial behaviour in almost all cases without deterioration in cognitive functions" (22). Narabayashi, who had performed amygdalotomies for behavioural disorders from the early 1960s, reported the long-term results of his operations in 1966, concluding that amygdalotomy had been more beneficial to younger (5 to 13 years old) than to older (11 to 35 years old) patients (38). Considering that Laitinen knew Narabayashi personally and appreciated his work (9), the former's willingness to operate on children is not so surprising.

Table 2. The ages of the patients who underwent a stereotactic psychosurgical operation in the Department of Neurosurgery by the time of their first operation.

Age	Men	Women	Total
5-9	1	-	1
10-14	3	1	4
15-19	3	5	8
20-24	16	10	26
25-29	14	5	19
30-34	10	4	14
35-39	7	3	10
40-44	3	9	12
45-49	9	8	17
50-54	5	4	9
55-59	4	7	11
60-64	1	2	3
65-69	-	1	1
Mean	33	38	35
Total	76	59	135

In many studies on the history of lobotomy, the number of lobotomized women has been found to be higher than that of men (13, 39-41). In the Department of Neurosurgery, stereotactic psychosurgery was, however, performed more often on men than on women: of the 135 patients, 76 (56%) were men and 59 (44%) women (Table 2). This cannot be accounted for by an over-representation of male patients in Finnish mental hospitals because women outnumbered men among inpatients. There were 9 500 men and 18 700 women in mental hospitals at the beginning of 1970 (35). There were also more women than men in the diagnostic categories that were the most common among the patients who underwent a stereotactic psychosurgical operation. The majority of the stereotactic psychosurgery patients were diagnosed with neurosis or schizophrenia (Table 3). At the beginning of 1970, only 33% of the patients with neurosis and 34% of the patients with schizophrenia in Finnish mental hospitals were men (35), whereas 67% of the operated on patients with neurosis and 54% of the operated on patients with schizophrenia were men (Table 3). There are, unfortunately, no statistics on the gender distribution between diagnostic subcategories. For example, the category of schizophrenia in the Eighth Revision of the International Classification of Diseases, which was used in Finland, includes, inter alia, the subcategories of catatonic and paranoid schizophrenia (42).

Table 3. The main diagnoses of the patients who underwent a stereotactic psychosurgical operation in the Department of Neurosurgery by the time of their first operation.

ICD	Diagnosis	Men	Women	Total
295	Schizophrenia	26	22	48
296	Affective psychoses	3	8	11
298	Other psychoses	-	2	2
299	Unspecified psychoses	-	1	1
300	Neuroses	37	18	55
314	Profound mental retardation	1	-	1
315	Unspecific mental retardation	7	7	14
324	Late effects of intracranial abscess or pyogenic infection (Depressive reaction)	1	-	1
812	Fracture of humerus (Drug dependence)	1	-	1
897	Traumatic amputation of legs (Drug dependence)	-	1	1
Total		76	59	135

If the patient's main diagnosis was not psychiatric, her or his psychiatric diagnosis is in parentheses.

As mentioned above, by far the most common diagnoses of the patients who underwent a stereotactic psychosurgical operation in the Department of Neurosurgery were neuroses and schizophrenia. The number of the operated on patients with neurosis (41% of the patients) is very high compared to the earlier use of lobotomy in Finland. In Seinäjoki District Mental Hospital, more patients underwent a lobotomy than in any other Finnish hospital (36). There, over 90% of the lobotomy patients had been diagnosed with schizophrenia and less than 1% with neurosis (43). According to Valenstein, only chronic patients with psychosis who were considered hopeless cases were originally selected for psychosurgery. Gradually, the prognosis for such patients was, however, noted to be poor. In the early 1970s, the best candidates for stereotactic psychosurgery were considered to be patients with anxiety, depression, hypochondriacal symptoms, obsessive-compulsive symptoms, phobias or tension. They were not as deteriorated as the earlier lobotomy patients, but their symptoms were severe and could prevent them from leading a normal life (34).

In Finland, the patients who underwent a stereotactic psychosurgical operation were referred for psychosurgery based largely on the same symptoms that Valenstein mentioned when describing the best candidates. The patients were usually referred because of aggressiveness, anxiety, depression, obsessive-compulsive symptoms, phobias, restlessness or tension, but most often because of anxiety. Many of the patients had either attempted or considered suicide. The majority of the patients had suffered from mental symptoms for at least five years; however, a few were operated on only a couple of years after the first occurrence of the symptoms (22).

The initiative in considering psychosurgery rested on the psychiatrist (44), who referred the patient to the Department of Neurosurgery. There, the patient usually underwent pre- and post-operative psychological examinations conducted by Juhani Vilkki, the neuropsychologist on Laitinen's psychosurgical team. Some patients also underwent pre- and post-operative psychiatric examinations. Based on the preoperative examinations, Laitinen decided whether to undertake the operation (22, 44-46). Sometimes the patient himself sought a psychosurgical operation, as in the case of a 28-year-old man who suffered from severe anxiety. When he was in Veikkola Sanatorium, he met a patient who had undergone a psychosurgical operation and became enthusiastic about psychosurgery. In September 1970, he went to Laitinen's practice, and Laitinen sent him to the Psychiatric Clinic of Helsinki University Central Hospital for examination. The psychiatrists of the clinic were of the opinion that "the examination time is too short to form a definite conception of the patient, and the performance of a possible operation is left to the surgeon's discretion". Laitinen performed a cingulotomy on the patient in October 1970 (22).

If the first operation did not produce the desired outcome and the patient's symptoms were not alleviated, the patient could be operated on again. One or more reoperations were performed on 38 (28%) of the 135 patients who underwent a stereotactic psychosurgical operation in the Department of Neurosurgery. Reoperations were more often performed on men than on women: 25 (33%) of the men and 13 (22%) of the women were operated on more than once (Table 4). One man was operated on as many as five times, whereas one woman who underwent an amygdalotomy in 1971 and a cingulotomy in 1972 had already undergone a lobotomy in 1961 (22). 183 stereotactic psychosurgical operations in all were performed in the Department of Neurosurgery from 1967 to 1975 (Table 4).

Psychosurgery was not indicated only because the patient happened to have some of the above-mentioned symptoms. In order for an operation to be performed, the symptoms had to be relatively long-standing, severe, and otherwise intractable. In 1969, Matti Apo and Raimo Miettinen, psychiatrists from Paihola Hospital, reported on a patient on whom a stereotactic lobotomy had been performed.⁶ They wrote that the patient was initially being considered for a lobotomy "because the illness had continued for over two years and intensive hospital care for over a year and a half"⁷ and that, according to the contemporary opinion, lobotomy was only indicated if electroshock and psychotropic drugs had proved ineffective and the patient's prognosis seemed hopeless (20). Apo and Miettinen used the word lobotomy, but the same applied to psychosurgery as a whole. In 1984, Apo and Eero Keskinen, also from Paihola Hospital, reported on the results of stereotactic psychosurgery performed in the 1960s and 1970s on patients from the Mental Health District of North Karelia. They argued that psychosurgery could improve the patient's condition in selected cases, namely when other treatments had proved ineffective (37). In the patient records of the Department of Neurosurgery, Laitinen often gave his reason for the selection of the psychosurgical procedure. He might conclude, for example:

"The patient is a 46-year-old man, whose very difficult anxiety and tension neurosis has now continued for three years. Pharmacotherapy has brought only very little relief, and psychotherapy has reached a dead end. For this reason, the patient is, in my view, well-suited for a mesoloviotomy examination." (22)

⁶ To be exact, the operation was a capsulotomy, but Apo and Miettinen did not know this; in the patient records of the Department of Neurosurgery, Laitinen also referred to the operation as a stereotactic lobotomy (22, 23).

⁷ Translated from Finnish by the author.

# of operations	1	2	3	4	5	Total
Men	51	19	5	-	1	76
Women	46	11	2	-	-	59
Total	97	30	7	-	1	135

Finnish psychiatrists had been of the opinion that lobotomy was something of a last resort when nothing else could improve the patient's condition (20, 47, 48). Although the opinion seems to have been the same in relation to newer psychosurgery in Finland and elsewhere (49, 50), some patients were operated on in the Department of Neurosurgery before, for example, electroshocks had been given to them. One such patient was referred from a small mental hospital called Harjavalta Hospital in 1972. The patient was a 17-year-old girl, who had been diagnosed with phobic neurosis and referred for psychosurgery in the hope of ridding her of anxiety and phobias. The referring doctor wrote in his letter to the Department of Neurosurgery that electroshocks or insulin shocks had not been given to the patient and professed that he was sceptical on their effectiveness in her case. The patient underwent a mesoloviotomy in 1972, a cingulotomy in 1973, and a capsulotomy in 1974 (22). By comparison, in Denmark, stereotactic psychosurgical operations were also performed on patients who had not received shock treatments (19).

The indications for psychosurgery, which could be learned, for example, from medical congresses and literature, were clearly regarded as recommendations rather than absolute rules. At the Second International Conference on Psychosurgery in 1970, William Beecher Scoville, an American neurosurgeon, spoke on the selection of patients for psychosurgery, and although he noted that, in cases of serious psychoses and psychoneuroses, shock treatments should be attempted before considering surgery, he believed that shock treatments were of little value in the majority of psychoneuroses. Scoville also stated that severe obsessive-compulsive neuroses with obsessive or phobic thinking were known to be intractable and that shock treatments made them worse (49). If the psychiatrist knew that shock treatments would be of no use or even of harm in some cases, why would he resort to such treatments before referring the patient for psychosurgery?

Valenstein wrote on the subjectivity of the indications for psychosurgery in his report for the (US) National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research in 1977. According to him, psychiatrists were divided on what treatments they regarded as alternatives to psychosurgery and for how long they explored the alternatives. He also stated that because many psychiatric disorders were believed to be progressive, psychiatrists often stressed the danger of postponing surgery for too long (50).

Good results?

Laitinen's and his co-workers' views on the results of the stereotactic psychosurgery performed in the Department of Neurosurgery can be learned from articles and conference papers by Lauri Laitinen (neurosurgeon), Juhani Vilkki (neuropsychologist), and Matti Apo, Eero Keskinen and Raimo Miettinen (psychiatrists). The patient records of the Department of Neurosurgery rarely contain much information on the results, as the patients usually left the department soon after the operation (22). The first article in which the results of stereotactic psychosurgery were dealt with was published in 1969 by Apo and Miettinen. The authors only reported on one patient, who, according to them, had undergone a stereotactic lobotomy (the operation was actually a capsulotomy⁸). The patient's depression had been relieved by the operation, and the patient had been discharged from the mental hospital a couple of months later (20).

In 1970, Laitinen and Vilkki presented a paper on the short-term results of 20 cingulotomies on psychiatric patients at the Second International Conference on Psychosurgery. In post-operative psychological examinations, an improvement in psychomotor activity had been noted in the patients whose condition had allowed psychometric testing; side effects had only been noted in one patient, whose imaginative capacity had declined. In 9 (45%) patients, the result of the operation had been regarded as "good", in 9 (45%) as "fair", and in 2 (10%) as "poor" (51). The results had been mainly evaluated based on the changes in the patients' symptoms. For example, on the operated on patients with schizophrenia, Laitinen and Vilkki stated that the short-term results were "dominantly positive" and that, "Seven of the 10 patients became completely free from anxiety and fears". Although a couple of patients had been categorized as "poor", "poor" clearly meant that the patients' symptoms had remained unchanged (51).

⁸ See note 6.

In 1971, Apo, Laitinen and Vilkki published an article on the short-term results of nine cingulotomies on patients who had been operated on in the Department of Neurosurgery because of intractable anxiety of schizophrenic origin. From 2 to 16 months post-operatively, neither complications nor decline in intellectual or emotional functions had been registered in the patients. In 4 (44%) patients, the operation had been regarded as having brought "very marked improvement" (i.e. the patients' symptoms had disappeared more or less completely, and the patients had been discharged), in 3 (33%) "marked improvement", in 1 (11%) "slight improvement", and in 1 (11%) "no improvement". In the patients who had shown "marked improvement", most symptoms had disappeared completely or almost completely, and the patients had been placed in a mental hospital for chronic patients. In the patient who had shown "slight improvement", most symptoms had alleviated, and the patient had been placed in an open ward in a district mental hospital, whereas the initial symptoms of the patient who had shown "no improvement" had remained almost the same (52).

In 1972, Laitinen and Vilkki presented a paper on the short-term results of 36 mesoloviotomies on psychiatric patients at the Third International Congress of Psychosurgery. One patient had had a haemorrhage during the operation (53). Apparently, no other complications had been registered. In post-operative psychological examinations, a non-significant decline in imaginative capacity had been noted in the patients whose condition had allowed psychometric testing, but, on the other hand, the examinations had indicated that mesoloviotomy immediately improved the patients' emotional state and possibly some memory functions. From 1 to 12 months post-operatively, 7 (19%) patients had been regarded as "symptom free", 13 (36%) as "much improved", 8 (22%) as "improved", and 8 (22%) as "not improved". No patients had been regarded as "worse" (53). The results had been mainly evaluated based on the changes in the patients' symptoms, as the most positive category was "symptom free".

In 1973, Laitinen and Vilkki published an article on the short-term results of 46 cingulotomies and 26 mesoloviotomies on psychiatric patients. No complications had been registered in the patients, but some psychological side effects had been noted in the form of a significant decline in imaginative capacity in the cingulotomy patients and non-significant in the mesoloviotomy patients (54). A decline in initiative, a possible side effect of lobotomy (13), was also considered a possible side effect of cingulotomy and mesoloviotomy. The cingulotomy patients had been observed for 14 to 47 months and the mesoloviotomy patients for 6 to 14 months. In 23 (50%) cingulotomy patients and 16 (62%) mesoloviotomy patients, the result of the operation had been regarded as "good", in 12 (26%) cingulotomy patients and 4 (15%) mesoloviotomy

patients as "fair", and in 11 (24%) cingulotomy patients and 6 (23%) mesoloviotomy patients as "nil" (54). The authors did not explain the principles of their categorizations, but, as previously, the results had most likely been mainly evaluated based on the changes in the patients' symptoms.

Interestingly, no patients had been categorized as ambiguous or worse in the 1970 conference paper or in the 1973 article by Laitinen and Vilkki, even though some significant psychological side effects had been noted and some patients had continued to suffer from their initial symptoms. In the 1970 and 1972 conference papers, in the 1971 article, and most likely in the 1973 article as well, the authors had used a symptom-oriented method of evaluation: if the patient's symptoms had been alleviated, the patient had been regarded as improved; if the symptoms had not been alleviated, the patient had been regarded as unchanged. The problem with this kind of method is that the possible changes in the patient's personality as a whole are not taken into account (19). Hence, the patients whose imaginative capacity had declined did not have to be categorized as ambiguous or worse. In 1975, when Vilkki presented a paper on the results of cingulotomies and mesoloviotomies at the Fourth World Congress of Psychiatric Surgery, he had categorized some patients as "worse". The symptoms of the patients in this category had become more severe post-operatively, and two patients had committed suicide (55). Although some patients had now been regarded as worse, still, the results had been mainly evaluated based on the changes in the patients' symptoms.

In 1982, some Danish psychiatrists and psychologists published a report on the long-term results of stereotactic psychosurgery performed in Denmark. They argued that the evaluation of the patient's mental condition was largely a matter of opinion and criticized the symptom-oriented method of evaluation, which had been used in many investigations. In their opinion, the method was grounded on the erroneous belief that the patient's symptoms could be eliminated without any interference with the patient's personality. The authors had evaluated the results of the operations performed on 65 patients without focusing solely on the changes in the patients' symptoms. They had regarded 16 (25%) patients as "improved", 6 (9%) as "unchanged", and 24 (37%) as "worsened". In 17 (26%) patients, the result of the operation had been regarded as "ambiguous" (i.e. the alleviation of the patients' symptoms had been accompanied by side effects) (19).

In 1984, Apo and Keskinen published an article on the short- and long-term results of stereotactic psychosurgery performed on 29 patients from the Mental Health District of North Karelia. Most patients had undergone a cingulotomy, a mesoloviotomy, or both during one operation; one patient had undergone an innominotomy and one an amygdalotomy and an innominotomy during one operation. Five patients had been operated on more than once. The short-term results of the operations had been evaluated when the patients had been discharged from one of the mental hospitals of the district for the first time after the operation. Seven patients had not been discharged. In close resemblance to the evaluation of the results in the 1973 article by Laitinen and Vilkki, over 50% of the patients had been categorized as "symptomless" or "clearly better". The long-term results had been evaluated from 7 to 14 years post-operatively. Three (10%) patients had been regarded as "symptomless", 6 (21%) as "clearly better", 8 (28%) as "slightly better", and 3 (10%) as "unchanged". Nine patients (31%) had died. Once again, no patients had been categorized as ambiguous or worse, even though nine patients had shown clear signs of dementia, and in one patient, who had been operated on five times, "the dementia likely resulted from the operation"⁹ (37). This can be explained by the symptom-oriented method (the most positive category was "symptomless"), which had been used in the evaluation.

If the results of stereotactic psychosurgery had been evaluated to be good in the Finnish investigations, this had also been the case in many foreign investigations (38, 56-60). The Finnish investigations, as well as many other investigations, can be criticized on the basis that, in them, the results of the stereotactic operations had been mainly evaluated focusing on the changes in the patients' symptoms (19). However, one should keep in mind that, for example, in Finland, the operated on patients had been severely ill for a long time and their symptoms had often prevented them from leading a normal life. Hence, the most important aim of stereotactic psychosurgery was to make the symptoms disappear. As stated by Juhani Vilkki in 1981, when he published an article on the psychological changes in some of the patients who had undergone a capsulotomy, a cingulotomy, or a mesoloviotomy in the Department of Neurosurgery:

"The deficits or any other detrimental changes which could be direct consequences of the operations were less incapacitating than the preoperative anxiety and the other disturbing symptoms, which were often alleviated by the operations." (61)

⁹ Translated from Finnish by the author.

Ends and beginnings

In Finland, lobotomy was replaced by stereotactic psychosurgery, which can be seen, for example, from the annual reports of mental hospitals. This is a quotation from the 1970 annual report of Huutoniemi Hospital:

"During the year, one of the patients of the hospital underwent a new brain operation, a so-called cingulotomy, in the Neurosurgical Clinic in Helsinki. This sort of selective brain surgery has completely replaced the classic lobotomy."¹⁰ (62)

Although lobotomies were performed in Finland in the 1970s, their number during that decade is very small compared to the number of stereotactic psychosurgical operations: only nine lobotomies were performed on psychiatric patients in the Department of Neurosurgery of Turku University Central Hospital from 1970 to 1975¹¹ (63). The lobotomy era from 1946 to 1975 can be regarded as having constituted the first wave of Finnish psychosurgery and the stereotactic psychosurgery era from 1967 to 1997 the second wave. The first wave was a much larger one, with over 1700 lobotomies performed around the country.¹² During the second wave, psychosurgery was already in the margins of Finnish psychiatry, and the wave can be seen to represent the end of ablative psychosurgery causing irreversible lesions.

In 1976, Henry Troupp, Lauri Laitinen's colleague, was appointed Chief Physician of the Department of Neurosurgery and Professor of Neurosurgery of the University of Helsinki. During the same year, he prohibited the use of stereotactic psychosurgery in the Department of Neurosurgery. One of the main reasons behind the prohibition was an ethical question: Does anyone have the right to permanently alter another human being (66)? Laitinen soon resigned from his position, left Helsinki, and moved to Bergen,

¹⁰ Translated from Swedish by the author.

¹¹ The last operation, which was also the last lobotomy in Finland, was performed on a woman from Vakka-Suomi District Hospital, who had been diagnosed with schizophrenia, in December 1975.

¹² The author argued elsewhere that 1573 lobotomies were performed in Finland (36). The annual reports of Oulu District Mental Hospital and Oulu Central Mental Hospital used in that study only listed 123 lobotomies, but the patient records of the hospital reveal that 251 operations were performed in Oulu and some of the patients of the hospital were also operated on in Helsinki (64). In addition, at least nine lobotomies on psychiatric patients were performed in the Department of Neurosurgery of Turku University Central Hospital (63), and at least one lobotomy was performed in Uusikaupunki Region Hospital (65). Hence, the number of performed lobotomies in Finland is actually over 1700.

Norway. In 1980, Laitinen moved from Bergen to Umeå, Sweden (9), where he revived the practice of stereotactic and functional neurosurgery in the Department of Neurosurgery of Umeå University Hospital (12). Lauri Laitinen passed away in November 2005 (67). After Lars Leksell, his personal idol (68), he is remembered as the second most prominent stereotactic neurosurgeon in the Nordic countries (12).

In 2009, the first DBS operation on a psychiatric patient in Finland was performed in the Department of Neurosurgery (69). In DBS, stimulation electrodes are implanted stereotactically in the brain in order to correct disturbed brain function. Most stimulation electrodes have several leads, which enable the stimulation of different areas with numerous combinations of stimulation parameters without changing the location of the electrode. The stimulation electrodes are connected to a neurostimulator implanted subcutaneously in the chest (26). DBS is reversible, unlike ablative psychosurgery, since the electrodes can be removed from the patient's brain (70).

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