Neurosciences and History 2014; 3(3): 130-135

The history of leucotomy

M. Balcells
Department of Neurology. Hospital Universitari del Sagrat Cor, Barcelona, Spain.

ABSTRACT

The present study addresses the introduction of psychosurgery as a treatment option for psychiatric patients. The use of surgery for certain mental illnesses gained importance at a time when no pharmacological treatments for psychiatric disorders had been developed.
This technique, first applied to psychiatric patients by clinical neurologists Egas Moniz (Portugal) and Walter Freeman (USA), was based on previous neurophysiological findings reported by John F. Fulton at Yale University, who practised frontal lobotomy on monkeys.
However, leucotomy progressively fell out of favour due to its lack of scientific rigour and disparate therapeutic results. The introduction of chlorpromazine by Jean Delay and Pierre Deniker signalled the advent of psychoactive drugs, after which lobotomy was definitively ruled out as a treatment option for psychiatric patients.

KEYWORDS
Neurosurgery, psychiatry, neurology, physiology of the nervous system, leucotomy

Among the many neurosurgical devices kept by the SEN's we find a leucotome, the tool that inspired the present article. We present a history of leucotomy as treatment certain psychiatric disorders, spanning its rapid spread during the first half of the 20th century to its decline in the era of psychoactive drugs. We also address the criticism it received due to disparity of results and the limited animal experiments performed by those promoting the technique.

Neurosurgery dates back to ancient times. Trepanation is one of the oldest surgical procedures known to humanity. The first trepanned skull was found in 1685 by Bernard de Montfaucon in Cocherel, France.[1] This practice has been documented in skulls dating back to the Neolithic. In Spain, Campillo has studied 20 trepanned skulls discovered in the Balearic Islands and 15 found along the eastern coast between Barcelona and Alicante. Most of these skulls date back to the Chalcolithic or the Bronze Age, and some even pertain to the Neolithic period.[2] Trepanation was probably performed as ritual, although according to some authors, including Krogman and Oakley, it had a therapeutic significance.[1]

Therapeutic trepanation was practised in the ancient and classical cultures (Egypt, Greece, and Rome). Celsus (25 BC-50 AC) and Galen (129 AC-216 AC), for example, used trepanation to treat head trauma and epilepsy. Although trepanation was practised during the Middle Ages and the Renaissance, it was not until the late 19th century that surgery began to be the brain.[3]

One of the first known cases of frontal lobe syndrome was that of Phineas Gage, who in 1848 suffered a work accident when an iron bar was driven under his left cheekbone and into the skull, damaging the left frontal lobe. The bar exited the skull along the midline, at the intersection of the sagittal and coronal sutures. As a result, Phineas Gage presented personality changes including disinhibition and irresponsible and antisocial behaviour.[4]

The first operation to remove a clinically diagnosed brain tumour was performed in England in 1884 by surgeon Rickman Godlee (1849-1925). The tumour was apparently a glioma. The patient died of meningitis one week after surgery.[3]

Corresponding author: Dr Miquel Balcells Riba
E-mail: balcellsriba@gmail.com

Psychosurgery arrived on the scene in 1888, when Johann Gottlieb Burckhardt (1836-1907) performed a topectomy (partial resection of the parietal and temporal cortices) on a patient with severe behaviour disorders. The resected areas were thought to be responsible for these disorders, and a total of six patients underwent the procedure based on this diagnostic hypothesis. This surgery and its results received harsh criticism from the medical community and Gottlieb Burckhardt stopped performing the procedure.

The Second International Neurological Congress was held in London in 1935. John F. Fulton (1899-1960), professor of physiology at Yale University, presented his findings on a study analysing behaviour in chimpanzees before and after undergoing bilateral resection of the prefrontal cortex.[4]

Fulton's findings, which are described in his book on physiology of the nervous system, were based on the delayed-response test: the subject (a chimpanzee in this case) is shown two differently-coloured boxes, one of which contains food. After several attempts, the animal guessed which of the boxes contained the reward. The food was then removed without the chimpanzee being able to see this. When the test was performed again and the chimpanzee discovered that the food was gone, it became agitated and shrieked:

> An adolescent female (...) proved also to be an emotional animal, greatly upset whenever an error was made in the delayed reaction or other test. In these circumstances it not infrequently flew into a violent temper tantrum, during which she rolled on the floor, beat the cage, defecated and urinated, and often showed signs of diffuse sympathetic discharge.
>
> The training was continued over a period of three weeks, and toward the end of it the temper tantrums became so frequent and cooperation so poor that further testing became impossible."[5]

Experimenters noticed dramatic changes after removing the two frontal areas of the brain:

> The usual procedure of baiting the cup and lowering the opaque screen was followed. The chimpanzee did not, however, show its usual excitement, but rather quietly knelt before the cage or walked around. Given an opportunity, it chose between the cups with its customary eagerness and alacrity. However, whenever the animal made a mistake, it showed no emotional disturbance, but quietly awaited the loading of the cups for the next trial. The opaque door was again lowered, but without untoward effect, and if the animal failed again it merely continued to play quietly or to pick over its fur. Thus, while the animal repeatedly failed and made far greater number of errors than it had previously, it was quite impossible to evoke even a suggestion of an experimental neurosis.

The experiment was a sensation among those who witnessed it, even though another chimpanzee, Lucy, displayed the opposite reaction: before the intervention, showed no significant signs of frustration when performing the test, but after frontal lobe ablation displayed violent behaviour.

Portuguese neurologist Egas Moniz (1874-1955) and American neurologist Walter Jackson Freeman (1895-1972) attended the international congress held in London. Egas Moniz soon ushered leucotomy into the field of clinical psychiatry.

Working in partnership with neurosurgeon Almeida Lima (1903-1985), he indicated leucotomy for chronic psychiatric patients based on Fulton's experiments. In 1935, he developed a procedure to disconnect the thalamus (dorsomedial nucleus) from the prefrontal lobe by means of two burr holes placed 3 cm behind the canthus of the eye and 5.5 cm above the zygomatic arch. In the first few interventions, 0.2 mL of alcohol was injected into the centrum semiovale to reduce the risk of bleeding; this anatomical region was selected due to the high density of fibres and the low concentration of blood vessels it presents. The number of injections ranged from 3 to 6. The leucotome, a tool used for performing leucotomies, could subsequently be introduced. This tool had a sharp distal end and a long handle. Once correctly placed inside the small burr hole, it could be rotated to section the white matter of the upper part of the frontal lobe. Lipiodol was then injected through the incision to delimit the topography of the lesion.

In 1936, Egas Moniz reported his findings from 20 patients who underwent surgery to the Paris Society of Medicine. During the postoperative period, which included a few days of follow-up, patients were observed to be more calm, less aggressive, and more manageable, although most of them were confused and clumsy. The scientific community questioned the effectiveness and indications of this type of intervention due to the limited body of clinical results and the short follow-up period.[6]

The International Conference on Psychosurgery was held in Lisbon in 1948 and it featured several pertinent

communications (Figure 1). Yahn, Mattos Pimenta, and Alfonso Sette reported findings from 233 chronic schizophrenic patients undergoing leucotomy; Jiri Semotán of Prague shared his experience with 149 patients; and Magnus C. Petersen and J. Grafton Love, from Rochester, described results from 235 patients treated over 7 years. A.M. Fiamberti, an Italian psychiatrist who introduced transorbital lobotomy, also shared his experience with 100 patients treated with his technique, which, he claimed, achieved substantial improvements in chronic patients with aggressive and disruptive behaviour.[6,7]

In the introduction to the conference, Egas Moniz stated that surgical treatment was indicated for psychotic patients since their thought processes depended on the stability of specific synaptic circuits responsible for cerebral function. This hypothesis was in line with Cajal's postulates that neurosis was due to reiterative or distorted thoughts and had an organic substrate arising from certain neuronal circuits. Likewise, Egas Moniz accepted Pavlov's conditioned reflex theory. Clinical experience involving patients with tumours in the frontal lobe and corpus callosum underlined the frontal lobe's prominent role in cognitive function. Based on these experiences, surgically severing frontal lobe connections seemed an obvious approach that would improve the symptoms of mental illnesses.[7]

In 1949, Moniz was awarded the Nobel Prize in Medicine for his discovery of leucotomy as a therapeutic option for psychiatric patients. As a result, this technique was introduced and promoted in numerous countries.

Lobotomy, which was the first surgical technique to be considered psychosurgery, spread quickly despite being a novel and risky procedure. This can be explained by the lack of treatments for psychiatric patients: at that time, treatment options were limited to patient isolation or restraint, hydrotherapy, electroshock therapy, and Sakel's controlled insulin comas. More than 15 years would pass before the first psychiatric drugs were introduced.

A great number of mental patients were institutionalised due to the lack of appropriate drug treatment; many of these were long-term stay patients who experienced progressive deterioration. According to a recent study by R.A. Robison providing data from 477 US asylums in 1937, there were more than 450 000 hospitalised mental patients and the cost of these institutions was estimated at more than $24 billion.

These figures evidence a significant socioeconomic problem which, along with the lack of drug treatments, inevitably promoted the practice of surgical interventions, especially among neurologists and organicist psychiatrists.[4]

Walter Jackson Freeman, an American clinical neurologist, also attended the Second International Neurological Congress and expressed a great deal of interest in Fulton's experiments and Moniz's leucotomy technique. Freeman asked neurosurgeon James W. Watts (1904-1994) to collaborate with him, and in September 1936, they performed the first prefrontal lobotomy in the US. By the end of that year they had already performed 20 surgeries. Surgical patients frequently experienced postoperative complications, such as motor disturbances and convulsive seizures. These results initially limited the procedure, and only 12 lobotomies were performed in 1937.

Freeman was a firm supporter of Herrick's hypothesis. According to this neuroanatomist, cognition and emotion had an organic substrate: the connections between the frontal lobe and the thalamus.

In light of the frequent side effects of the procedure, Freeman began employing Amarro Fiamberti's method. Since 1937, this Italian psychiatrist had been performing lobotomies transorbitally and injecting alcohol or formalin into the frontal lobes. Freeman adopted the transorbital approach and eliminated the prefrontal lobe-thalamic tracts using the orbitoclast, a tool he developed himself; it resembled an ice pick and had gradation marks on the shaft. The orbitoclast was placed behind the eye socket and introduced into the frontal lobe by hammering the handle of the instrument. The instrument was subsequently swept medially and laterally to section the fibres connecting the frontal lobe to the thalamus (Figure 2).

Transorbital lobotomy could be performed without anaesthesia and outside an operating theatre. Freeman would treat patients with electroshock therapy and then operate on them while they were in post-convulsive coma. The simplicity of Freeman's technique resulted in the indiscriminate use of lobotomy in psychiatric institutions across the US. It was Freeman himself who

Figure 1. Walter Freeman and Egas Moniz (middle). I International Conference on Psychosurgery, Lisbon (Portugal), 1948.

taught healthcare professionals at these institutions to perform the procedure.[8]

In 1939, Freeman and Watts described the results of treating 41 patients with lobotomy in an article published in *The Yale Journal of Biology and Medicine*. Their clinical and surgical experience with prefrontal lobotomy increased knowledge of the functions of the frontal lobe.[9]

In 1942, these authors published a monograph, *Psychosurgery*, reporting their results in 200 surgically treated patients: while 63% showed improvements, 23% experienced no changes and symptoms worsened in 14%. Watts disapproved of the poorly defined surgical method and the use of electroshock therapy as anaesthesia, which led him to end his professional relationship with Freeman in 1950.

Freeman, as previously mentioned, was not a surgeon, and yet he himself performed more than 3000 surgeries in 23 states, often in the patient's home. This was just one of many downsides to the procedure: lobotomy was performed indiscriminately on chronic patients for whom there was no hope for recovery, and results were not predictable. Many patients were left generally apathetic and indifferent to social and family relationships; some became uncommunicative and highly dependent,

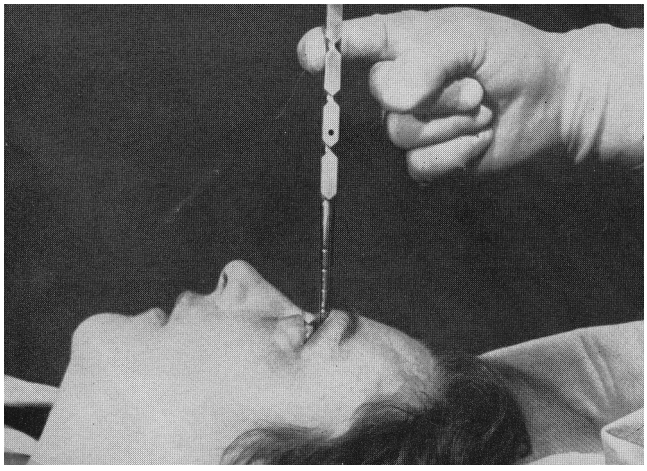

Figure 2. Walter Freeman performing a transorbital lobotomy with an orbitoclast. Picture published in the article *Transorbital lobotomy. The problem of the thick plate.*[8]

which are obvious signs of mental impairment. All of these factors contributed to the gradual decrease in the number of procedures performed. The decline of lobotomy was also motivated by several well-publicised failures, such as the cases of Helen Mortensen, who underwent three lobotomies and finally died of a cerebral haemorrhage, and Rosemary Kennedy, one of John F. Kennedy's sisters, whose psychiatric disorder exacerbated dramatically after she underwent a lobotomy. With the introduction of psychoactive drugs, beginning with chlorpromazine in 1952, lobotomy was only indicated in specific cases and for patients who were resistant to pharmacological treatment.

In 1971, Freeman published a study of 707 lobotomised patients who had been followed for periods of 4 to 30 years. Although many of these patients had experienced improvements, 73% were still institutionalised or housebound.

In 2001, Uchino et al. at Hospital in Saga (Japan) published a study analysing the sequelae of prefrontal lobotomy in MR images of 8 patients with schizophrenia who had undergone transorbital lobotomy according to Freeman's technique some 50 years previously.

Images displayed bilateral cavitary lesions in the white matter of the anterior frontal lobe, which contained a fluid resembling CSF. These patients also showed frontal lobe cortical atrophy and dilated frontal horns of the lateral ventricles, and different degrees of atrophy of the genu of the corpus callosum, a finding indicative of Wallerian degeneration of the fibres connecting the temporal pole and the corpus callosum.

In their literature review, these authors mention several neuropathology studies in which all lobotomised patients displayed frontal lobe atrophy and degenerative changes in the medial dorsal nucleus of the thalamus, with a significant reduction in the number of cells.[11]

The available statistics about patients undergoing this type of surgery provide some interesting insights. In 1950, Freeman described his experience with 1000 surgery patients in the US, reporting a treatment failure rate of 20%, potentially positive outcomes with long-term follow up in 30%, and marked improvements in social interaction in 50%. In 1955, Riser reported total recovery in 45% and limited or no results in 55% of a total of 400 patients. In 1968, Post et al. published a study of 54 patients who were examined 7 years after surgery. The study reported satisfactory results in 40%, mediocre results in 21%, treatment failure in 31%, and disastrous results in 8%. In 1971, Laboucarié published results from 149 patients undergoing surgery between 1949 and 1969. He achieved satisfactory results in 55% of the patients lobotomised between 1949 and 1959 (115 patients), 77% of those treated between 1960 and 1966 (18 patients), and 66% of those treated between 1967 and 1969 (16 patients).[12]

It is difficult to compare results patients undergoing lobotomy for several reasons: 1) lack of consensus about the clinical diagnosis; 2) the patient's personality before surgery; 3) total disease progression time; 4) the time elapsed between disease onset and the intervention; and 5) any questions arising about symptoms that may be attributable to either disease progression or to the surgical procedure.

Conflicts of interest

The author has no conflicts of interest to declare.

References

1. Balcells M. Historia general de la neurología. Esplugues de Llobregat (ES): Grupo Saned; 2009.

2. Campillo D. Paleopatologia: els primers vestigis de la malaltia. Barcelona: Fundación Uriach 1838; 1993.
3. Prim J. Los primeros neurocirujanos. Barcelona: Edicions Bellaterra; 2007.
4. Faria MA. Violence, mental illness, and the brain - A brief history of psychosurgery: Part 1 - From trephination to lobotomy. Surg Neurol Int. 2013;4:49.
5. Fulton JF. Fisiología del sistema nervioso. Mexico City: Atlante; 1941. [Fulton JF. Physiology of the nervous system. Oxford University Press]
6. Acharya HJ. The rise and fall of frontal leucotomy. In: Whitelaw WA, ed. The proceedings of the 13th annual history of medicine days. Calgary (AB): Faculty of Medicine, University of Calgary; 2004.
7. International Committee on Psychosurgery, ed. Proceedings: International Conference on Psychosurgery. Lisbon: Luso-Espanhola; 1949.
8. Freeman W. Transorbital lobotomy. The problem of the thick plate. Am J Psychiatry. 1952;108:825-7.
9. Freeman W, Watts J. An interpretation of the functions of the frontal lobe. Yale J Biol Med. 1939;11:527-39.
10. Lanska DJ. Freeman II, Walter. In: Aminoff M, Daroff R, eds. Encyclopedia of the neurological sciences. San Diego: Elsevier; 2003.
11. Uchino A, Kato A, Yuzuriha T, Takashima Y, Kudo S. Cranial MR imaging of sequelae of prefrontal lobotomy. AJNR Am J Neuroradiol. 2001;22:301-4.
12. Ey H, Bernard P, Brisset C. Tratado de psiquiatría. Barcelona: Toray-Masson; 1975.