

Spiegel E A, Wycis H T, Marks M & Lee A J. Stereotaxic apparatus for operations on the human brain. *Science* 106:349-50, 1947. [Dept. Experimental Neurology, Temple Univ. Sch. Med., Philadelphia, PA]

A stereotactic apparatus is described permitting production of exactly placed subcortical lesions in the human brain with minimal impairment of other areas. The use of intracerebral reference points and application in psychosurgery are reported. Further indications (intractable pain, involuntary movements, subcortical tumors) are envisaged. [The SCI[®] indicates that this paper has been cited in over 100 publications since 1961]

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"In the winter of 1947, I watched a prefrontal lobotomy being performed and I was appalled by the resulting extensive brain damage and by the severe personality changes. It occurred to me that a reduction of the emotional and behavioral disturbances attempted by lobotomy could be obtained also by small lesions of the thalamic dorso-medial nucleus that forms a circuit with the frontal lobe. Such a lesion would avoid severance of the association fibers caused by lobotomy. H.T. Wycis, a neurosurgeon participating in research in my department, enthusiastically accepted my proposal of such thalamotomies.

"These procedures required not only the building of a stereotaxic guiding apparatus similar to Horsley and Clarke's¹ employed in animals, but also the preparation of a special atlas of the human brain. Due to the great variability in the shape of the human skull, reference points on the skull as used by Horsley and Clarke¹ on animals were unreliable. Intracerebral reference points had to be chosen such as a calcified pineal gland or parts of the circumference of the cerebral ventricles visualized roentgenologically, e.g., the anterior and posterior commissures. The procedures using intracerebral reference points have been called stereoecephalotomy,² stereotaxic neuro-

surgery, or stereotaxy. This special atlas had to show brain sections in frontal, sagittal, and horizontal planes. The illustrations were supplied with millimeter scales, so that the coordinates of subcortical structures in relation to the above mentioned reference points could be measured. Their variability also was determined. The tedious work of preparing such an atlas and of measuring the coordinates was greatly facilitated by the faithful cooperation of Wycis. He also followed meticulously my suggestions during these operations. The first stereotaxic thalamotomies were performed in spring 1947.

"At an American Medical Association exhibit of labyrinthine studies (June 1947), several visitors surprisingly asked me about details of our unpublished thalamotomies. This alerted me to the importance of an early publication. This paper describing a stereotaxic instrument for man and its application in psychosurgery was published in *Science* in 1947. Here some further possible applications of stereoecephalotomy were mentioned (intractable pain, involuntary movements, subcortical tumors). Later, convulsive disorders refractory to conservative treatment became an additional indication.²⁻⁴ The preoperative, roentgeno-logical visualization of the ventricles and/or of the pineal gland also was mentioned in the original publication.

"This technique has been widely used because it permitted one to produce exactly localized subcortical lesions with minimal injury of other areas. Thus, neurosurgeons in the US and Canada (151 according to Gildenberg⁵), in practically all European countries,^{3,4} in Mexico, South America, Japan, India, and Thailand became interested in stereotaxic neurosurgery. Societies for this new discipline were founded —an international, an American, a European, and a Japanese one.

"I was awarded honorary MD degrees by the Universities of Zurich and Vienna; honorary presidency of the International Society for Stereotactic and Functional • Neurosurgery; honorary membership of the American EEG Society, the German Neurosurgical Society, and the Mexican National Society of Medicine; the Foerster Medal (German Neurosurgical Society), and the Erb Medal (German Neurological Society)."

1. Horsley V & Clarke R H. The structure and function of the cerebellum examined by a new method. *Brain* 31:45-124, 1908.
2. Spiegel E A & Wycis H T. *Stereoecephalotomy: thalamotomy and related procedures*. New York: Grune & Stratton, 1952-62. Vols. I & II.
3. Riechert T. *Stereotactic brain operations*. Bern: Huber, 1980. 387 p.
4. Schaltenbrand G & Walker A E. *Stereotaxy of the human brain*. Stuttgart: Thieme, 1982. 700 p.
5. Gildenberg P L. Survey of stereotactic and functional neurosurgery in the United States and Canada. *Appl. Neurophysiol.* 38:31-7, 1975.