Evaluation of Thalamic and Subthalamic Surgical Lesions in the Alleviation of Parkinson's Disease

CHARLES A. FAGER, M.D.
Department of Neurosurgery, Lahey Clinic Foundation, Boston, Massachusetts

ALTHOUGH most attention in the surgical treatment of Parkinson's disease has been focused on nuclear regions in the lateral floor of the thalamus, small minority of stereotaxic surgeons have made lesions in subthalamic structures. Exploration of specific subthalamic areas has been made possible by improved instrumentatation, including the smaller electrodes and more precise apparatus for depth-recording and stimulation. The most commonly used operations have been Spiegel's campotomy in the H fields of Forel, Meyers' approach to the substantia nigra, and Andy's subthalatomy. Other surgeons have placed lesions in a position that produces a zone of destruction in the ventro-oral thalamus and the subthalamic fiber tracts immediately below. Thus, Van Buren directs the electrode tip to a target 2 mm below the intercommissural line; Bertrand passes the electrode through the nucleus ventralis posterolateralis and extends the lesion into the subthalamic area immediately below this nucleus; and Kjellberg introduces the electrode in a horizontal plane so that a lesion is produced on the floor of the thalamus itself.

It has been suggested that a small surgical lesion in the network of fiber tracts composing H1 or H2 or in field H might be less hazardous and just as effective as a large lesion in the thalamus. During the past 4 years at the Lahey Clinic, a small radiofrequency electrode has been carried to the surgical target by the McPherson stereotaxic instrument. The uninsulated tip of the electrode measures 5×1.1 mm and contains a thermistor to monitor the degree of tissue generated. The danger of hemorrhage has been virtually eliminated by temperatures 70° to 75°C in an electrode tip of this size. The size of the lesion can be enlarged by varying the time factor from 2 to 6 minutes. The largest area of destruction has been an 8 to 9 mm sphere, the smallest approximately half the size. Careful control over the production of the lesion combined with improved radiographic visualization of the anterior and posterior commissures (Fig. 1) has permitted deeper explorations as well as refinements in the conventional approach to the nucleus ventralis lateralis.

The main purpose of this study has been to evaluate the electrode depth in relation to the commissural plane (the lowermost portion of the thalamus) and the result obtained in the production of each lesion. Obviously there were many variable factors which made conclusions difficult. No attempt was made to select a certain group of patients for a subthalamic lesion and others for a thalamic or combined thalamosubthalamic lesion; the decision was simply made to attempt either a thalamosubthalamic destruction or a smaller subthalamic lesion. In instances in which the conventional larger lesion in the basal part of ventralls lateralis or the so-called nucleus ventralis oralis failed to abolish tremor or rigidity, the electrode was passed deeper within the same tract as far as the commissural plane or below to produce a second lesion.

The subcommissural surgical lesion, whether solitary or contiguous, was always made smaller than the thalamic lesion. Because of our limited knowledge concerning the effect of surgical ablation in these deeper areas, it seemed prudent to preserve as much of the subthalamic nucleus as possible and to avoid the medially coursing fibers of the internal capsule. Consideration was also given to the possible additive effect of these lesions upon an extrapyramidal system already damaged by disease.

Cases were studied only if both the anterior and posterior commissures could be seen radiologically and if there was no question of the location of the midsagittal plane. Radiological technique was improved by the use of small Polaroid cassettes attached to the stereotaxic instrument at a rigid and fixed tube-to-film distance for lateral and postero-

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anterior exposures. For positive contrast, Pantopaque was instilled into the ventricular system through a small frontal burr hole and then manipulated into the third ventricle with the patient in a sitting position. The remainder of the stereotaxic procedure and the combined stimulating and radiofrequency electrode for production of the lesion\textsuperscript{7–9} have already been described.

The principal objective in reviewing these cases was to establish some correlation between the depth of the lesion and the effect on symptoms, rather than to determine the duration of the over-all effectiveness of surgery. In patients who had more advanced disease, the purpose of the operation was palliative and in this sense was often successful for 2 or 3 years. These patients, however, were included in this study as well as others who apparently had unilateral parkinsonism and the likelihood of a more lasting result.

The surgical target developed during the last 9 years has been largely based on the data of Yakovlev, et al.\textsuperscript{26} The primary electrode position has varied with the intercommissural distance; Table 1 shows the initial position of the electrode with intercommissural distances varying from 23 to 28 mm. In the thalamic range the electrode tip was estimated at 14 mm lateral to the midsagittal plane. The primary target in most cases has been low in the nucleus ventralis lateralis or in the posterior portion of Hassler's nucleus ventralis oralis, unless an initial subthalamic lesion was planned. As shown in Table 2, if the electrode was placed 2 mm or more above the intercommissural line, the bulk of the lesion produced was presumed to be thalamic. If the electrode extended to the zone from 2 mm above to 2 mm below the intercommissural line, the bulk of the lesion was thalamo-subthalamic; if the tip was placed 2 mm below the intercommissural line or lower, the lesion was deemed subthalamic. Figure 2 is a diagrammatic representation of the direction of the electrode aimed at the primary and deeper

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<th>Intercommissural Distance (mm)</th>
<th>Distance of Electrode Tip Posterior to Anterior Commissure (mm)</th>
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