Stereotaxic Radioisotope Scanning
An Experimental Technique for the Conversion of Discrete Focal Positive Scans into Coordinates for Neurosurgical Access*

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Like many neurosurgeons, we have been intrigued with the possibilities of making additional diagnostic and therapeutic use of the 3-dimensional picture of a brain lesion displayed by a positive anteroposterior and lateral brain scan. It seemed to us that if such a picture could be transferred accurately to stereotaxic coordinates it would allow controlled and repetitive access to the areas of positive brain scan seen in tumors and other pathological conditions of the central nervous system without the necessity of contrast neuroradiography to display internal reference points.

Our first attempt in this direction was simply to superimpose the anteroposterior and lateral positive brain scan with the ear, nasion and inion marked, over the anteroposterior and lateral skull x-ray films of the same patient. These x-rays were taken with the patient’s head in a stereotaxic frame. The center of the positive scan was then marked on the operative skull films in the anteroposterior and lateral projection, and the coordinates of the stereotaxic instrument were set to this designated target. No positive biopsy was obtained from insertion to this target point in spite of the fact that the focal area of the positive scan was rather large. With a free hand insertion, the tumor was then encountered several centimeters from the previously selected target area. Rather disappointed with this simple but obviously inaccurate method, we proceeded next to design an instrument and technique to reduce such large errors. This development utilized components of the Bennett stereotaxic apparatus to which additional instrumentation has been added for our purposes as described below.

Materials and Methods

Instrumentation. A rectangular stereotaxic frame with provisions for attachment to a standard American Sterilizer operating table was constructed. The dimensions and markings of this frame were the only parts similar to the basic rectangular frame of the Bennett instrument. We were thus able to position the patient on the operating table with his head held by the attached frame. Anteroposterior and lateral brain scans could be carried out with the patient lying first on his back and then on his side, the attached stereotaxic frame moving with the patient’s head. The isotope scanning was carried out in the operating room with a Picker portable Magna scanner. A 3-inch crystal was used with either a 19 or a 31 hole collimator head. The usual dose of 500–900 microcuries of Hg219 labeled Neohydrin was injected intravenously 4 hours before the operative scan.

Technique. Only patients with a recent positive routine scan showing discrete foci of increased uptake were selected for the following procedure. With the frame attached to the head and the patient in position for a lateral scan with the side of his previously positive scan uppermost a 10X12 cm. plastic grid marked in 2 mm. squares was mounted on the stereotaxic frame, and placed over the general area of positive radioisotope uptake as seen on the previous scan (Fig. 1). The position of the central axis of this grid was noted from a centimeter scale on the lateral bars of the frame. The central light beam of the collimator head was then placed over each corner of the grid thus marking the four corners on the photoscan film and the dot scan paper (Fig. 2). Repeated trial of this step proved that a 1 to 1 relationship existed between the actual grid size and the grid outline marked in this manner on the film and paper. The grid was then removed and the scan carried out over the grid area at the optimum distance indicated by preliminary data on the phantom scans (ride infra).

After the lateral scan, the patient was turned to the supine position for an anteroposterior scan. As before the grid was placed in its special holder on the anterior bars of the stereotaxic frame over the general area of the preceding positive lateral scan and its position was also noted on the anterior centimeter scale. The corners of this anteroposterior grid were marked on the film and paper in the same way as the lateral scan, and the anteroposterior scan of the grid area was then carried out after removal of the grid and its supporting holder. In each scanning position the stereotaxic frame and the collimator head were leveled with respect to the horizontal and vertical planes respectively and maintained in this relationship during the scanning procedure.

The anteroposterior and lateral grids were then mounted on a separate phantom frame. This was the original Bennett frame, identical with the one on the patient’s head. The grids were fastened in the same position they occupied on the patient’s frame during the scanning procedure.
Fig. 1. Scanning the corners of the grid attached to the lateral bars of the stereotaxic frame on the patient's head. Note the collimator head moving to mark a corner of the grid on the photo and dot-scan record with the patient's head in position for a lateral scan. The double grid is indicated by the arrow.

Fig. 2. View of the stylus marking the corners of the grid on the dot-scan paper. A similar mark appears on the photoscan film. A complete grid outline is shown by the black arrow.

Following development of the photoscan, the areas of focal increased uptake on the anteroposterior and lateral positive scans were cut out around the corners of the previously marked grid outline. These photoscan cut-outs were then mounted with clips in proper orientation onto their respective grids utilizing the corner markings. A view of the lateral grid seen through the photoscan cut-out is shown in Fig. 3. A phantom target device attached to the phantom frame and movable in 3 planes was then manipulated to the desired area of the positive scan as measured on the grids. The height and sagittal plane setting of the target area were taken from the lateral grid plus photoscan and the offset from the midline was taken in a similar manner from the anteroposterior grid plus photoscan (Fig. 4A).

The patient was then placed in a supine position and a burr hole was made over the approximate area of positive scan, and the dura opened in the usual way. The

Fig. 3. A view of the lateral grid with a cut-out of the lateral photoscan superimposed. The target point selected for biopsy in the area of focal increased uptake is marked with a circled X. The lateral coordinates were obtained from this arrangement of cut-out scan film and grid. Note the dark dots marking the corners of the grid pattern on the photoscan film (arrow). A similar arrangement with the A-P photoscan gave the required offset from the midline (A-P coordinates).