NEUROSURGICAL INSTRUMENT GUIDE AND STEREO LOCATOR

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(Received for publication September 26, 1961)

Instruments for stereotactic exploration of and placement of lesions in the human brain must, of necessity, vary with the intentions and requirements of their users, which also vary greatly. Some requirements, such as for great accuracy with reproducibility of reaching the target on second or third entries days apart in time, are incompatible with others which may be for low cost, simplicity, quickness in use, or comfort and reasonable mobility of the patient. The investigator who wishes, incident to therapeutic effort, to explore systematically deep structures by means of recording and stimulation, not only on one occasion but on subsequent occasions days apart, and who wishes to relate his data to external or internal landmarks with the greatest precision, requires a device capable of being oriented undeviatingly time after time and of translating the target point reached into measurements on spatial coordinates with an accuracy of a millimeter or less. Such requirements call for fixation to the skull at three or more points and this, in turn, entails lengthy setup and operating time, decrease in mobility of the patient and some increase in discomfort of the patient. Such an instrument will be more or less weighty, costly and generous in size. The surgeon whose objective is wholly therapeutic and who wishes to reach but a single target one time only, as a rule, may be served better by an instrument that allows him to reach the general neighborhood of his target, perhaps with an error of a few millimeters on first insertion, and which then permits him to make adjustments based upon the results of recording or stimulation prior to the making of the lesion. Such an instrument may function by fixation of the skull to a single point only, be less costly to make and use, and demand of the operator less time and of the patient less discomfort and restriction of mobility during the intervention.

The instrument described here possesses as desirable features: 1) rigid bony fixation at a single site—the trephine hole itself; 2) completely independent adjustment of position of the target-seeking electrode or leukotome in the three coordinates of space; 3) suitability for use in the dysskinetic awake patient who cannot be fully immobilized; 4) suitability for use with easily available roentgen-ray apparatus, including portable machines; 5) accuracy of first insertion to target of 3 to 4 mm. with accuracy of secondary adjustment of 1-2 mm., should the result of recording or stimulation show need for such adjustment; 6) minimum effort and time in maintenance and use.

Though amply accurate for physiological seeking of targets in depth, it is less suitable for systematic exploration of loci, particularly multiple, determined wholly by measurement from external or internal landmarks. Nor is it suitable for the repeated reaching of the same target on first insertion on different occasions. Thus, it would seem to have features that commend its use for therapeutic objective by the surgeon who wishes to reach dependably a physiologically determined target for the purpose of making a destructive lesion. In such applications the instrument has evident advantages over more or less "free-hand" guides, including those utilizing ball-and-socket or swivel joints and other contrivances that do not allow for completely independent adjustments on coordinates one at a time.

THE INSTRUMENT

The device (Fig. 1) is composed of three parts or assemblies: 1) a hollow taper-threaded tap screw 1 inch in diameter; 2) an instrument guide with friction-locking trunnions which fixes securely to the hollow tap screw; 3) a "T"-shaped localizing device through the extremities of which project physical facsimiles of the target-seeking instrument. The target-seeking electrodes and leukotomes which have been used with this instrument are those described by Bertrand.1

The hollow tap screw features a short-threaded segment properly dimensioned so as to thread tightly into a 1-inch trephine hole. Just above the threaded portion is a thin hexagonal segment to which one may apply a box or other type of wrench for turning the screw into the trephine hole. Rising above the hexagonal segment is a cylindrical collar to which is fitted the needle guide. The needle-guide assembly (Fig. 2) consists of a longitudinally drilled member which swings on axes at a right angle with provision for frictional binding of the trunnions by tightening of appropriate screws. These movable members are attached to a circular base which is split on one radius and provided at this site with a screw for tight fixation to the cylindrical collar of the tap screw. The "T"-shaped member with limbs of equal (5 inches) length has at the point of union of the three limbs a hole with a locking screw to permit tight fixation to the upper extremity of the trunnion-swung needle guide. At the ends of the limbs of the "T"-shaped
mid-line as the target to be reached. The dura mater is opened by multiple radial incisions and the cortex exposed in the center of the opening is treated appropriately to facilitate later penetration by the electrode or leukotome. If air has not been introduced into the ventricles by the lumbar route prior to this stage, direct ventricular injection is carried out, taking care to introduce enough air to allow visualization of the internal landmarks one intends to use. The hollow tap screw is then turned tightly into the trephine hole. On this hollow screw the adjustable needle guide is seated and tightened provisionally with the locking screw, taking care that the axis of the outer trunnion is visually parallel with the sagittal line. This is not critical and a few degrees of lack of parallelism introduce no significant error, though ease of completion of subsequent stages is facilitated by achieving close approximation of the axes of the needle-guide trunnions with the sagittal and coronal lines.

The approximate depth of the target to be reached being known, one now positions the three facsimile needles in the extremities of the "T"-shaped member to this anticipated depth, making sure that all project the same distance. The set screws holding these facsimile needles are then tightened lightly and the "T"-shaped member is affixed to the needle guide taking care to orient the part so the rostrally projecting part of the "T"-shaped member is visually parallel with the sagittal line and with the sagittally oriented axis of the outer trunnion. This results in the coronally oriented limbs of the "T"-shaped member being parallel with the coronal line. At this point, before final tightening of the binding screw of the "T"-shaped member on the needle guide, careful review of parallelism of the two axes with sagittal and coronal lines should be made.

One now proceeds to rectify the plane of the "T"-shaped member (and the imaginary plane described by the three points of the projecting facsimile needles) with a transverse plane of the head. This is accomplished most easily by producing parallelism of the facsimile needle projecting over the subject's face with the mid-line of the face (Fig. 3). A slight misdirection either toward or away from the mid-line is recognized easily without resort to measurement.

If the trephine hole has been centered properly at the same distance from the mid-line as the intended target, the tip of the facsimile needle at the nasion will lie an identical distance from the center of the face at the nasion. If the trephine hole has been centered a little too far from the mid-line, the tip of the facsimile needle will lie that distance too far lateral to the mid-line at the nasion. Such an error is not to be compensated for at this stage—rather parallelism of the