Stereotaxic device for percutaneous twist-drill insertion of depth electrodes and for brain biopsy

Technical note

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A stereotaxic device is described for percutaneous twist-drill insertion of depth electrodes for seizure recording and brain biopsy. This apparatus, which permits a lateral orthogonal approach, has been used in conjunction with a Leksell type of stereotaxic frame. Its main advantages are the ample working space it provides at the site of insertion of intracerebral electrodes, and the stable attachment it offers in fixing these electrodes on the skull.

KEY WORDS • stereotaxic surgery • depth electrodes • brain biopsy • seizure recording • instrumentation

THE orthogonal stereotaxic approach in neurosurgery was developed by A. Mussen around 1918 (unpublished material). Talairach, et al., 1 designed a double-grid system which also permits an orthogonal approach, that is, at a right angle to the frame and parallel to the central x-ray beam. Such a system facilitates introduction of intracerebral electrodes and biopsy needles by the lateral approach. Safety and accuracy are provided by angiography.

For the last 4 years, we have used a compact stereotaxic device of our own design that can be adapted to a modified Leksell frame. Our device uses an orthogonal approach combined with an x-y system of frame coordinates.

Description of Apparatus

The apparatus* comprises two main parts, a sliding side-bar and a carrier, both made of aluminum (Fig. 1). The sliding side-bar consists of two vertical posts joined together at their base by a larger bar on which is engraved a centimeter grid with numbers corresponding to those at the base of the stereotaxic frame. The vertical posts are grooved to permit vertical sliding displacement and locking along the vertical axis. The horizontal grid bar itself is a slide on which the carrier can be moved horizontally along the x-axis.

* Apparatus manufactured by Tipal Instruments, Montreal, Quebec, Canada.

Fig. 1. Photograph of the assembled apparatus. The sliding side-bar and the carrier can be fixed on both sides of the frame and brought to any target point by means of an x-y reference.
The depth of penetration into the brain (z coordinate) is calculated by means of a ruler equipped with a collet chuck. The distance between the collet and the 0 on the ruler equals the distance between the collet of the carrier and the middle of the frame.

FIG. 2. The depth of penetration into the brain (z coordinate) is calculated by means of a ruler equipped with a collet chuck. The distance between the collet and the 0 on the ruler equals the distance between the collet of the carrier and the middle of the frame.

The carrier, sliding horizontally on the side-bar, carries a collet chuck, the center of which lines up with the indexes on the carrier and on the vertical posts of the side-bar to indicate its position against the x and y gradations of the frame. Once a target has been determined, the collet chuck can readily be positioned according to its x and y coordinates. The depth of penetration along the mesiolateral axis z (the distance from the midline) is determined with a phantom ruler also equipped with a collet chuck. The distance from the collet chuck to the 0 on the scale equals that from the collet chuck mounted on the side-bar to the center of the stereotaxic frame (Fig. 2).

The collet chuck on the carrier supports and immobilizes a scalp punch, a twist drill, a screw-driver (for fixing hollow skull screws to anchor the electrodes), a dural coagulating electrode, a brain cannula, or a biopsy forceps (Figs. 3 and 4). The carrier is provided with a socket to mount a supporting rod and clamp which immobilizes the recording electrode on target while the brain cannula is withdrawn (Fig. 4).

FIG. 3. A twist drill is held in the collet chuck by a metal cuff. The drill perforates both tables of the skull.

FIG. 4. The recording electrode is placed on target through a brain cannula. A supporting rod and clamp immobilize the recording electrode on target while the cannula is withdrawn. Acrylic is used to fix the electrode to the screw.

Comment

To date, the most widely used stereotaxic instrument for implantation of intracerebral depth electrodes has been that of Talairach, et al. Their device permits an orthogonal approach through a double grid; however, teleradiology is necessary, and the working space available at the site of implantation is limited.

The apparatus we have developed makes it possible to insert electrodes through an orthogonal approach with either short- or long-distance x-ray facilities. This apparatus could be attached to any modified Leksell type of frame equipped with a vertical slide. The target coordinates are read in an unobstructed field directly from the frame gradations. The sliding carrier allows the surgeon to approach the precise target without the constraints of a grid with fixed distances between its apertures.

The main advantage of this apparatus is the ample working space it provides at the site of electrode implantation for positioning of hollow skull screws, and for the rigid fixation of recording electrodes within these screws. (Stable fixation is essential to obtain quality tracings free of artifacts.) The apparatus is also suitable for percutaneous biopsies of brain tumors and for the insertion of radioisotopes.

Reference


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