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Summary: We made an MR-compatible brain slice holder that ensures that the images have the same location and orientation as the subsequent histologic sections. This device encloses the unfixed tissues, thus reducing the danger of exposure to pathogens. MR imaging time is saved by scanning selected slices rather than the whole brain; this technique is especially useful when brain sections at varying angles, rather than parallel slices, are taken.

Index terms: Magnetic resonance, technique; Brain, magnetic resonance; Pathology

We constructed a magnetic resonance (MR)-compatible Lucite brain slice holder to use in scanning 1.5-cm-thick brain slices before they are processed for histologic analysis. The correlation of histologic preparations and MR images provides insight into the biology of disease processes. Seldom are MR images from the immediate antemortem period available for brains obtained at autopsy, but postmortem MR imaging can provide valuable correlative images. Suitable MR images can be obtained from fixed or unfixed brains or brain slices.

Burger (1) suggested that to ensure that a histologic specimen actually includes the abnormality detected by MR imaging, brain *slices* should be studied with MR imaging, and then the entire slice should be embedded and stained. Scanning brain slices rather than the whole brain is particularly important when the sections and images to be examined are not all confined to a simple series of parallel slices but include slices taken at several different orientations. In such cases, there is an increased possibility that the histologic sections and the MR images will not be precisely aligned. Furthermore, MR scanning can proceed as a series of parallel scans without changing the scan angle, as would be required in our particular study, for which brain slices are cut at specific oblique-coronal angles.

Boyko et al (2) demonstrated the use of postmortem MR imaging of brain slices in clinical pathology. Most of their formalin-fixed brains were imaged uncut. However, if a specimen already had been sectioned, individual slices were imaged or the slices stacked and the entire brain imaged as for the uncut specimens. Single slices could be imaged with a surface coil to obtain greater resolution.

The apparatus we constructed (Figs 1 and 2) contains five sliding trays, each capable of holding a brain slice up to 1.5 cm thick. There are two compartments, one at the top and one at the bottom, that can hold ice to keep the unfixed brain slices cold. Typically, the brain slices are obtained at autopsy, stored overnight in a buffer solution with weak (1%) formalin, and scanned

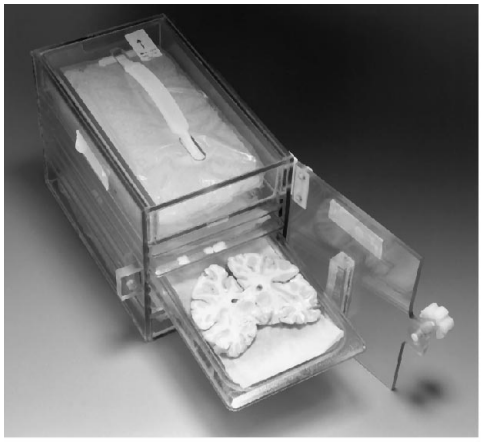

Fig 1. Brain slice holder with a brain slice on one of the five trays.

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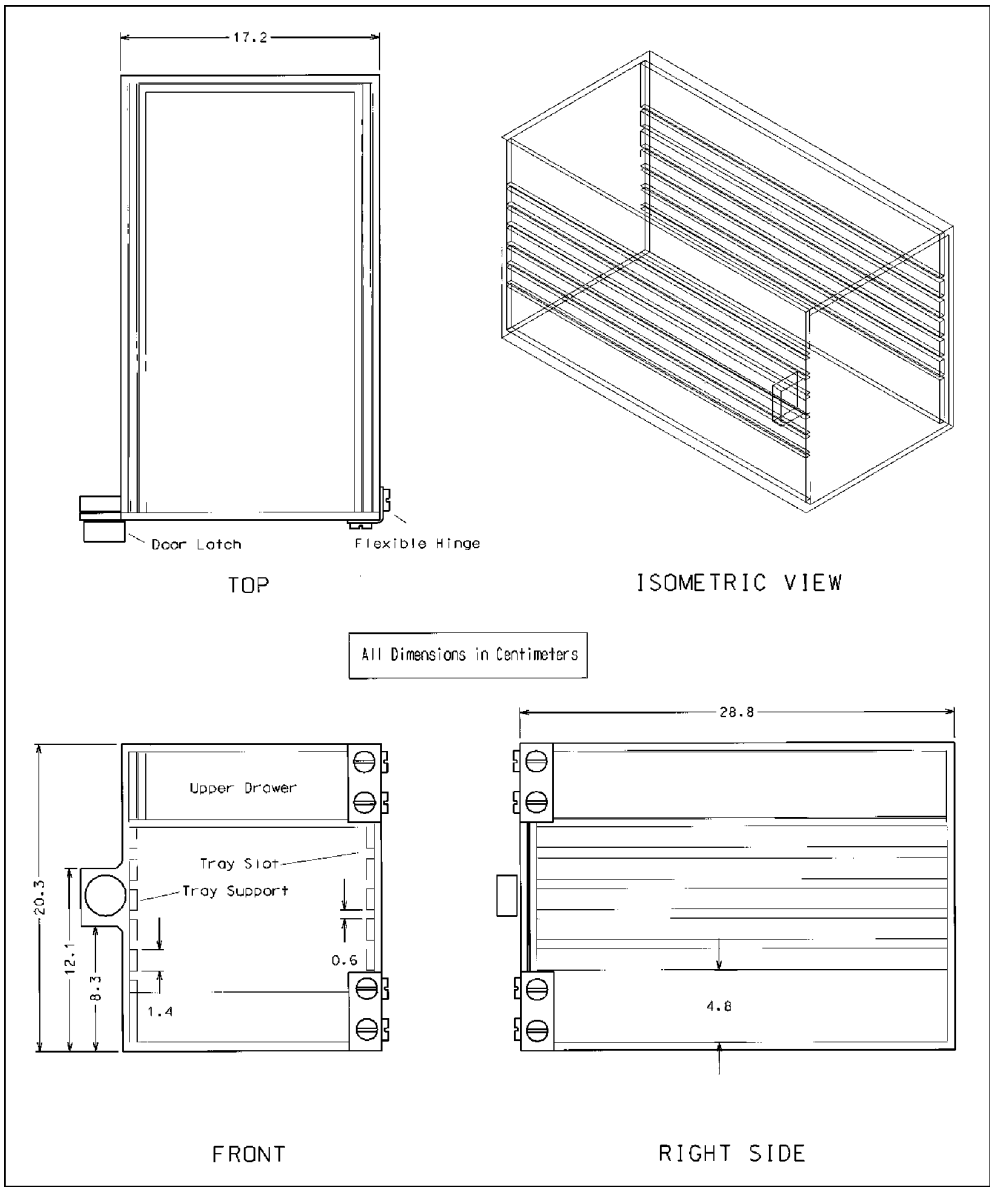

Fig 2. Technical drawing of the brain slice holder. It is constructed of glued 5-cm-thick Lucite panels and polyethylene screws, hinges, door knob, and handle. It contains five sliding trays at 1.5-cm spacing with a compartment at the top and another at the bottom that can hold ice. The dimensions of the plastic trays are 16 cm × 26.5 cm, formed to a shallow dish (Cambro CW-C-40 lid, New Frontier Restaurant Equipment, Winston-Salem, NC) (or comparable).

early the following morning before the clinical schedule begins. To obtain brain slices of uniform thickness, a cutting guide is used. The guide is essentially a tray with four rubber feet and 1.5-cm sides to guide the knife. After imaging, the entire slice can be embedded, cut, stained, and then examined by light microscopy. The holder safely encloses our incompletely fixed tissues and reduces the risk of exposure to pathogens in the MR imaging suite and during transport to and from the neuropathology laboratory. A plastic bag might be adequate to contain fixed tissues, but for unfixed tissues, the addition of ice space compartments is useful to minimize deterioration of the specimens.

The brain slices are placed on paper towels in the trays in sequence from anterior to posterior, and the holder is placed into the MR instrument with the superior aspect first, as a patient would lie for an MR examination. MR imaging of the brain slices is performed with a Picker (Cleveland, Ohio) Vista 1.5-T instrument. A T1 scout view is obtained initially to align the plane of

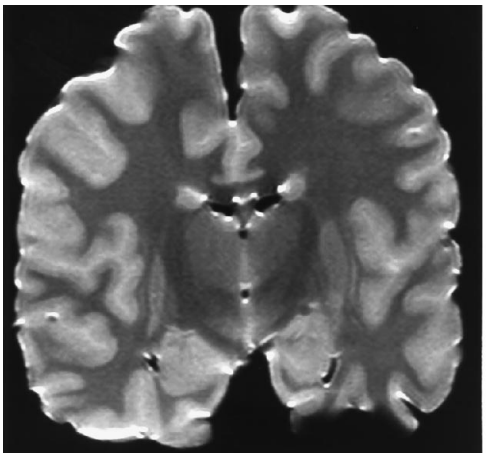

Fig 3. Proton-density (spin-echo 2600/30) MR image of a 1.5-cm-thick brain slice from a normal brain after overnight storage in buffer with weak (1%) formalin.

imaging in accordance with the tissue slices. A two-dimensional Fourier transform spin-echo sequence is then performed at 2600/30,80/1 (repetition time/echo time/excitations) with a 256 × 192 matrix, 3-mm-thick sections, no gap (interleaved), and a 15-cm field of view. Total scanning time is 8.5 minutes.

Although the brain slice holder produces susceptibility effects that distort the magnetic field, the head coil is tuned in such a way that the transmit and receive attenuator settings required for imaging are similar to those needed for routine clinical scanning. Normal structures on the proton density–weighted and T2-weighted images of brain slices have contrast ratios that are similar to those of normal structures or slightly improved on patient studies performed with similar imaging specifications.

Use of this brain slice holder ensures that the MR images are obtained from the exact location and in the same orientation as the subsequent histologic sections. When imaging a whole brain specimen, it often is impossible to anticipate the precise plane of gross sectioning, and there is no guarantee that a lesion identified on an MR image will be entirely contained within one of the gross sections. Because we are interested in specific sample areas from the brain, we can save MR imaging time by scanning the slices in a single plane. The brain slice holder is particularly useful in studies such as ours, because it is important that the sections for histologic study be at varying oblique-coronal planes so that the course of vessels penetrating the brain can be traced in profile, from the surface to their ultimate deep capillary beds. In postmortem studies surveying the whole brain, after fixation such a holder may not be required (2).

The quality of the MR images obtained through the middle portion of a thick brain slice is very good (Fig 3). Thick tissue slices are preferable, because they allow acquisition of several 3-mm-thick MR images without partial-volume effects. Susceptibility artifacts attributable to air-tissue interface at the edges of the brain are troublesome, but they do not hinder analysis of the deep cerebral white matter, which is the focus of our investigation. In comparing MR images of fresh brain slices with images obtained the following day, after slices were stored in weak buffered formalin, we found that overnight storage did not result in obscuring of abnormal hyperintensities in the T2 and proton-density MR images (3). Furthermore, we did not observe the hyperintense signal on T2-weighted images of the ventricular lining described by Boyko et al (2). Our tissue is stored overnight in a formalin solution with a concentration one tenth as strong as that commonly used for fixation. Therefore, our images are not affected by the same degree of fixation artifact.

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