Localization of brain tumors with a simple scalp-mounted fiducial device

Technical note

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A method is described for marking the site of a tumor on the scalp based on information from computerized tomography (CT) scans. The technique employs a syrinx-shaped array of radiopaque catheters of varying length taped to the patient's scalp for visualization on the CT scan. Fiducial markings on the CT images allow the transfer of the tumor's location directly onto the scalp. The device can be placed anywhere on the scalp, including in a parasagittal position.

KEY WORDS • brain neoplasm • tumor localization • computerized tomography

The desirability of locating small subcortical tumors prior to craniotomy is obvious. This knowledge allows proper placement of the scalp and cortical incision and results in a minimum of operative trauma. Various methods have been described, most of which require additional radiological studies or the use of expensive equipment. A simple inexpensive technique is described for accurate transfer of the tumor location from the preoperative computerized tomography (CT) scans to the scalp.

Device and Technique

The device consists of a flexible transparent plastic card, 110 x 90 mm in size, that has previously been described by Wester, et al.8 Molded into the card is an array of nine radiopaque catheters, 1.5 mm in diameter, with a center-to-center distance of 7 mm (Fig. 1). The catheters differ in length by a distance equal to the thickness of a CT slice. A hole through the plastic card is adjacent to the top of each catheter as shown in Fig. 1. The catheters in the array will be visualized as a series of dots on the transaxial CT scans. The card is taped to the scalp approximately over the location of the tumor. Contrast-enhanced CT scans are then made with the scans aligned parallel to the base of the card as shown in the scout view reproduced in Fig. 2. As the scan proceeds upward, fewer catheters are visualized and the number of dots indicate the level of the scan.

Figure 3 shows a scan where the center of the tumor is adjacent to the sixth catheter in the anteroposterior (AP) direction and at a level where eight of the nine catheters are visualized. Through the holes at the tops of Catheters 6 and 8, two points are marked on the scalp with a marker pen. The card is removed and the center of the target now lies at the 90° intersection of two lines drawn through the two points, one parallel and one perpendicular to the base of the card. The two points indicating the level and AP placement of the target are usually only 1 to 2 cm from each other so that the lines through them can be drawn freehand. The marked area on the scalp can be protected by surgical tape until the time of operation, usually on the following day. By this means, the skin, bone, and dural openings are positioned to correspond to the site and size of the tumor.

This device also allows the localization of tumors high on the convexity where the curvature of the skull is maximum and sagittal projections are of little help. In these cases the card is mounted with the long axis of the catheters in the AP direction, and coronal CT scans are performed. The number of dots seen on the scan locate the tumor in the AP direction and the catheter number adjacent to the tumor locates its position from the midline. Again, these points are simply marked on the skin and the center of the target is determined as described previously.

Discussion

This device constitutes a simple and inexpensive method for transferring target location from CT scans to the scalp. Although the method does require CT
CT localization of brain tumor

FIG. 1. Localization array showing the arrangement of the catheters. Note the hole over each catheter.

scanner time, the operation does not have to be performed immediately after the scan as is the case for localization methods on conventional stereotaxic frames. Fabrication of the device is simple using commonly found materials, and is within the competence of local hospital workshops.

The accuracy of this technique is in part dependent on the initial placement of the fiducial device so that the tumor is overlain by catheters in both directions.

FIG. 2. Computerized tomography scan showing a scout view of a patient with the localizer in place.

FIG. 3. Computerized tomography scan through the tumor. The number of dots indicates the level of the scan. The tumor is adjacent to Catheter 6.

This placement has proved fairly simple in practice; in the nine cases in which this technique has been performed it was necessary to reposition the card on only one occasion. This system also allows the localization of targets high up on the convexity close to the midline, an area subject to error with localization systems employing lateral skull projections.

References

1. Boethius J, Ribbe T: A new stereotactic instrument which can be used in conjunction with open surgery. Acta Neurochir Suppl 38:559-565, 1984

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