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Initial experience related to the use of the Cosman-Roberts-Wells stereotactic instrument

Technical note

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Initial experience with a new arc-radius design of stereotactic frame that interfaced with the existing components of the Brown-Roberts-Wells instrument is reported. Over a 6-month period, 32 procedures were performed on 23 males and nine female patients (mean age 32 years); these included 27 stereotactic biopsy procedures, two stereotactic implantations of cyst catheter reservoirs, two ventriculoscopic aspirations of third ventricular colloid cysts, and one stereotactic aspiration of a craniopharyngioma. In all cases successful targeting was achieved and verified by postoperative computerized tomography. There were no operation-related complications. This new frame offers rapid and accurate targeting and is a useful adjunct to the stereotactic armamentarium.

KEY WORDS • image-directed stereotaxis • stereotactic instrument • instrumentation • Cosman-Roberts-Wells stereotaxy

CONSIDERABLE experience has accrued in recent years with the application and development of image-directed stereotaxis.[1] Several years of practical application of the Brown-Roberts-Wells (BRW) polar coordinate instrument has facilitated the development of a prototype (preproduction) arc-radius design frame, created to offer the advantage of the arc-radius design while interfacing with the existing components of the BRW system.

System Design

The Cosman-Roberts-Wells (CRW) stereotactic frame is an arc-radius design unit that is developed to utilize the existing components of the BRW system to localize and verify target data. The prototype model consists of six major components: the standard BRW base ring, a magnetic resonance (MR) imaging or computerized tomography (CT) localizer unit, a CRW arc-radius frame, a phantom simulator, and the Epson microcomputer. Lesion localization is performed according to the standard BRW routine, utilizing the base ring fixed to the skull at four pin sites, and image-directed lesion localization with the MR imaging or CT localizer unit affixed to the base ring by way of three ball-in-socket joints. Target data are then input into the phantom simulator and CRW frame to assure correlation. A newly-developed localizer unit is available which fastens to the CT table and avoids the need for computer derivation of target coordinates (Fig. 1). The instrument is then utilized to assay tissue, target catheter placement, or perform stereotactic craniotomy in the standard fashion (Fig. 2).

Benefits to the arc-radius design include the capability of infinite non-predetermined entry points. This obviates the step of determining entry-point coordinates prior to the target computer calculations. The system allows an unimpeded stereotactic craniotomy, with the instrument design assuring no major frame support components above the level of the base ring to interfere with access. The design is compatible with the utilization of stereotactic laser surgery and ventriculoscopy, in addition to being able to target lesions with CT, MR imaging, positron emission tomography, or angiography. With the arc-radius design, transsphenoidal or suboccipital passes are achieved with a low base ring application and direct lateral passes are feasible. With the use of specially designed partial arcs, lateral placement of the base ring is possible (Fig. 2).

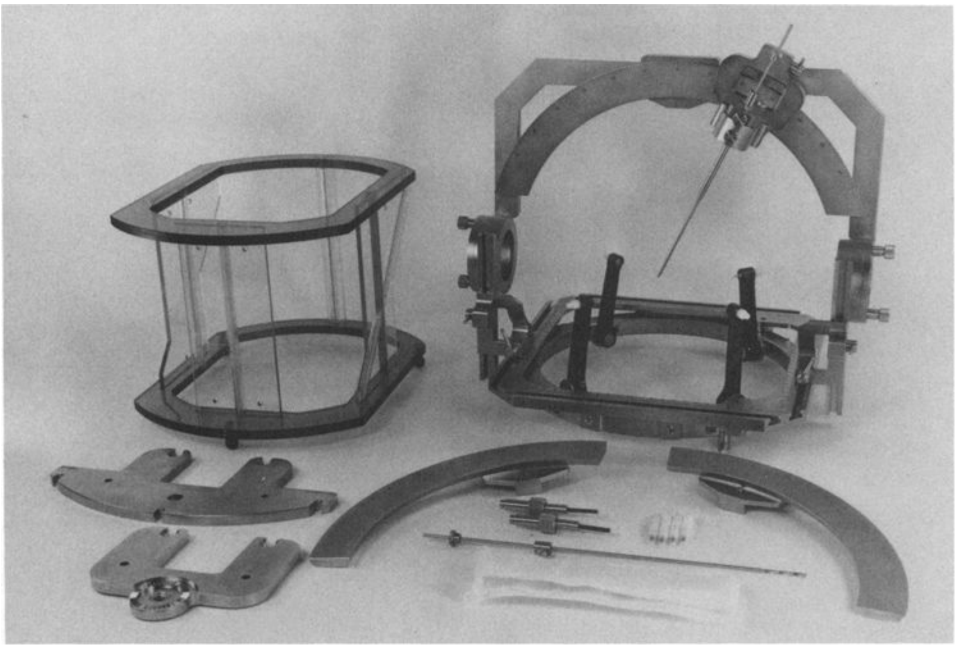

FIG. 1. The Cosman-Roberts-Wells (CRW) stereotactic system. Clockwise from upper right: the CRW frame affixed to the base ring, partial arcs (right foreground) to allow lateral placement of the base ring, the standard skull pins and $\frac{3}{8}$-in. drill used in biopsy procedures, the adaptation device to fasten the base ring to the standard Mayfield head holder and computerized tomography (CT) table (left foreground), and the specially designed CT localizer to allow extrapolation of target data without the use of the microcomputer.

TABLE 1
Initial experience with Cosman-Roberts-Wells system

Procedure	No. of Cases
computerized tomography-guided stereotactic biopsy procedures	
supratentorial	26
infratentorial	1
stereotactic placement of cyst catheter reservoir	2
ventriculoscopic aspiration of third ventricular colloid cyst	2
stereotactic aspiration of craniopharyngioma	1
total cases	32

TABLE 2
Pathological diagnosis in 26 biopsy specimens

Diagnosis	No. of Cases
glioma	18
lymphoma	2
hemangioblastoma	1
metastasis	2
infection	2
leukoencephalopathy	1

Clinical Results

Over a 6-month period at our institution, 32 patients underwent stereotactic procedures with the CRW unit. The mean age of the patients was 32 years; there were 23 males and nine females in the series. The patients underwent a variety of surgical procedures as summarized in Table 1. In all cases, targeting was confirmed using the phantom base, and postoperative CT scanning was performed to verify successful targeting in patients undergoing biopsy or reservoir placement. There were no operation-related complications. Of the 27 cases of stereotactic biopsy, tissue diagnosis was obtained in 26 (96.3%), comparing favorably with the BRW unit. The pathological diagnoses are summarized in Table 2. In the two patients who underwent ventriculoscopic aspiration of a third ventricular colloid cyst, postoperative CT revealed resolution of the cyst and attendant hydrocephalus.

Discussion

The first practical human stereotactic apparatus is generally acknowledged to have been introduced by Spiegel, *et al.*,[7] in 1947. Since that initial milestone, a myriad of different stereotactic devices have been developed utilizing similar principles for target localization.[4]

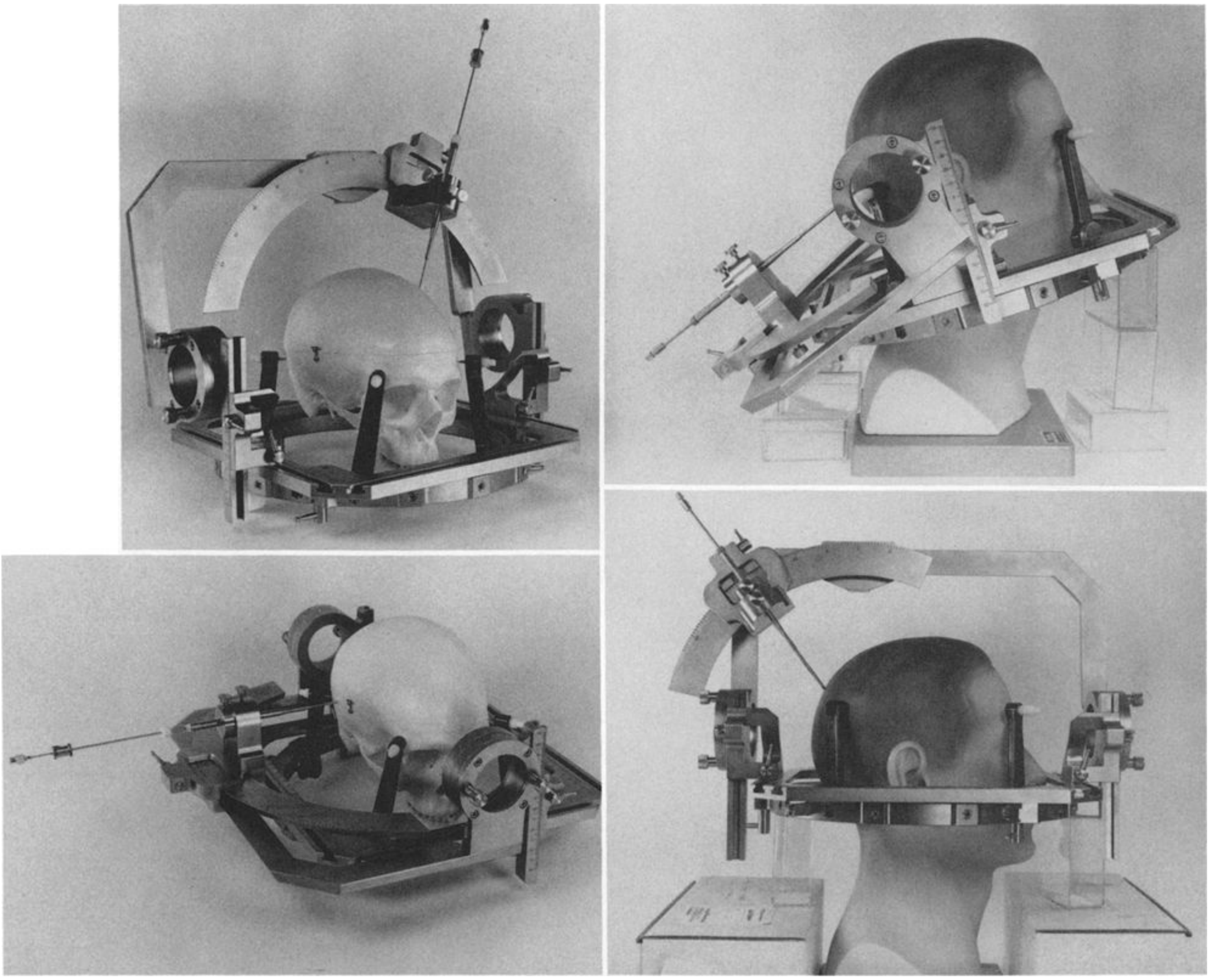

FIG. 2. *Upper Left:* The Cosman-Roberts-Wells (CRW) unit affixed to the skull using four-point fixation of the base ring. The CRW frame is attached to the base ring by way of three ball-in-socket joints. *Upper Right:* With adequate low placement of the base ring, direct posterior fossa trajectories are practicable. *Lower Left:* Demonstration of a direct lateral entry point approach is possible with the frame. *Lower Right:* Lateral placement of the base ring is feasible with the use of specially designed partial arcs.

The BRW instrument was developed initially for image-directed stereotaxy (CT in the original conception) and consists of interlocking arcs to generate the polar-coordinate system.[5] The design achieves excellent target localization accuracy. Because of the interlocking arc design and the complexity of adjusting the arcs to obtain trajectory, the coordinate definitions require the use of a portable microcomputer to assimilate the CT fiducial data and entry-point data.[3] The BRW stereotactic instrument has proved reliable, accurate, and durable over several years in more than 2000 procedures at the University of Southern California teaching hospitals.[2] The CRW frame has been developed to interface with the existing proven BRW components.

In 1950, the first arc-radius design instrument was introduced by Leksell.[6] Since that time, several modifications have evolved using the same central theme, that of intracranial probe length remaining equal to the arc radius. The arc-radius design offers inherent advantages, rendering preselection of entry-point data unnecessary. The natural corollary to this is that multiple biopsy trajectories are possible through a single entry point without the necessity of recalculating trajectory coordinates as in the polar-coordinate design. The base ring attachment allows unimpeded stereotactic craniotomy access, and the arc may be rotated clear of the immediate operative field and reintroduced at any time without loss of target localization.

Initial use of this system has demonstrated ease of use and reproducible accuracy comparable to the BRW system. It is yet another adjunct in the stereotactic armamentarium, with the additional benefit of utilizing components of a proven and universally available system.

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