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Head Immobilizer for Digital Video Subtraction Angiography

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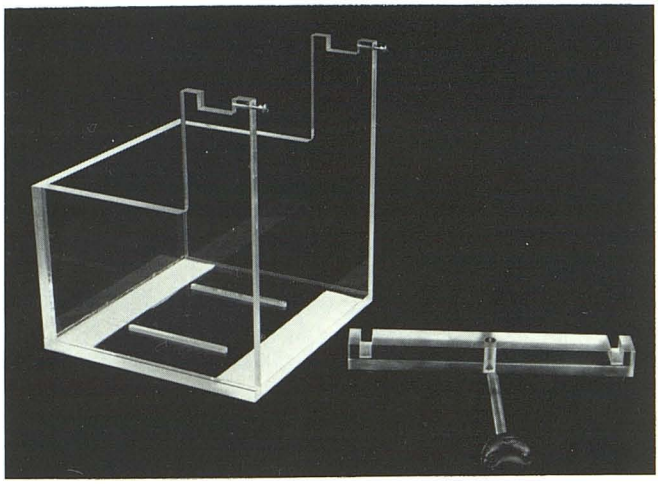
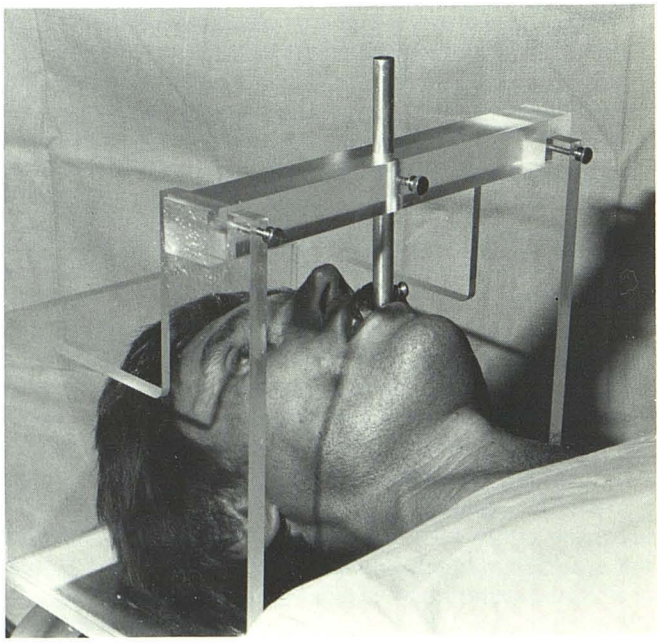
The digital video subtraction angiography system developed at the University of Arizona [1, 2] has proven to be an excellent tool for intravenous angiographic evaluation of many cervical, renal, and peripheral vascular disorders. Intracranial application has been more limited because of a combination of difficulties. Simultaneous opacification and consequent superimposition of cerebral vessels and limitations in spatial resolution are currently being addressed with technical refinements, such as improvements in x-ray tubes and image intensifiers, as well as stereoscopic and alternate biplane imaging. One of the most critical problems has been patient motion because the success of the technique depends on excellent registration, subtraction, and subsequent enhancement of a very dilute iodine concentration. This difficulty has been resolved to a limited extent by electronic reference frame shifting [3]. However, because even minor head motion is often rotatory and frame shifting is linear, this technique does not always succeed in eliminating misregistration artifacts.

Most of our patients who undergo cervical and cranial digital angiography are very cooperative as they realize that a successful examination may obviate a conventional angiogram. Nevertheless, it is difficult for many patients to remain perfectly still during the 15–20 sec of image acquisition, especially when they experience the surge of heat after an intravenous bolus injection of contrast material. We have therefore designed a simple head immobilizing device to assist the cooperative patient.

The patient's head is placed in a four-sided box constructed with ½ inch (1.27 cm) Plexiglas. A dental impression compound (Sybron/Kerr, Romulus, MI 48174) is heated in a water bath until soft and is then placed over a small metal bite bar attached to the end of a ½ inch diameter metal rod. The patient is asked to bite firmly but gently into the compound while it is still warm to form a dental or gingival impression. The metal rod with the dental impression is then slid through a hole in a 1¼ × 1½ inch (3.17 ×



A



B

Fig. 1.—Head immobilizer for digital intravenous cerebral angiography. **A**, Unit unassembled. Plexiglas box, cross piece, and metal bar with molded dental impression compound attached to end. **B**, Unit assembled. Supine patient bites onto dental impression mold.

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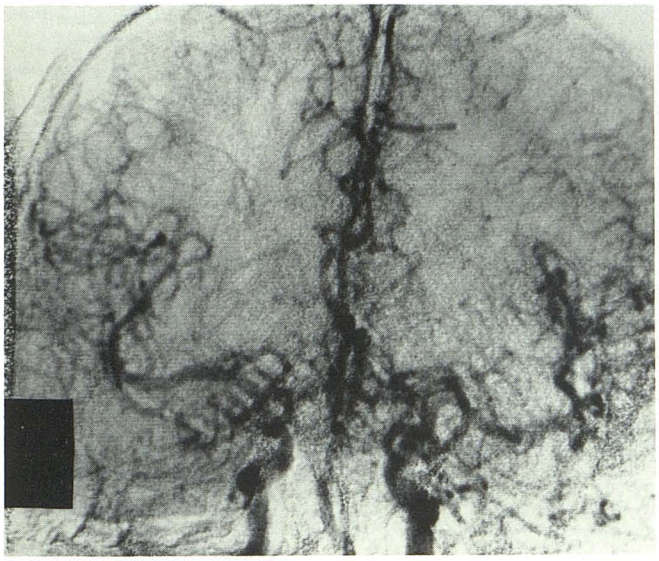

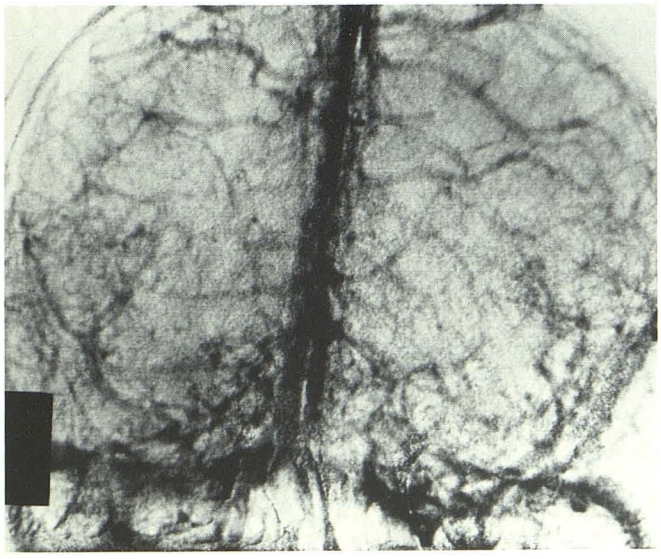

3.81 cm) Plexiglas crosspiece, which is then attached to the Plexiglas box. The bite bar is lowered into the patients's mouth and is tightened to the crosspiece with a set screw. The crosspiece is held firmly to the box, also with set screws. By biting onto his dental impression, the patient has a strut to aid in head immobilization during the imaging sequences (fig. 1). A strap may also be placed across the patient's forehead for further immobilization, but we have found this unnecessary. The crosspiece and rod can be lifted rapidly from the box if the patient should gag. Because vomiting is occasionally induced by injection of contrast material, we generally perform a cervical study without the head immobilizing device as a first injection.

In our first 40 patients studied with the head immobilizer, we noted a significant improvement in the quality of intracranial examinations, with good or excellent results in 35 (fig. 2). Resolution of small intracranial vessels was better than anticipated, probably due to a combination of immobilization and rapid injection of the contrast material (generally, 40–42 ml of Renografin 76) into the superior vena cava. Because the x-ray tube and detector are mounted on a C-arm assembly, most projections can be obtained with the patient in a comfortable, supine position.

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Fig. 2.—Normal intracranial study in 73-year-old man after injection of 42 ml of Renografin 76 into vena cava. **A**, Linear substracted and enhanced anteroposterior image 8 sec after injection. Log substracted and enhanced images 10 sec (**B**) and 13 sec (**C**) after injection show early and late arterial and venous phases, respectively.