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AJNR Am J Neuroradiol 1983, 4 (3) 588-589

<http://www.ajnr.org/content/4/3/588>

This information is current as
of August 23, 2025.

Stereoscopic Magnification in Spinal Angiography

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This technique combines the advantages of magnification and stereoscopic angiography. A heavy-duty x-ray tube oscillating between two positions (25 mm apart) allows serial spinal angiograms to be produced in stereo magnification (factor 2.0) using the 0.2 mm, 12 kW focal spot. The x-ray tube can be rapidly changed for normal serial angiography with a 0.6 mm, 50 kW focus. The technique is easy to use for spinal phlebography and arteriography. Vessels can be observed clearly in three dimensions. Difficulties relating to localization of veins (e.g., intra- or extraspinal) are eliminated. The feeding vessels, the draining system, and the exact location of spinal angiomas are more easily recognized. In many cases, only one injection of contrast medium is needed and the use of photographic subtraction radiography is unnecessary.

Technique

A new integrated method of stereoscopic serial angiography employs radiographic magnification and produces stereoscopic angiograms that resemble conventional angiograms. The method has been described by Takahashi et al. [1, 2] and by Doi et al. [3, 4]. In 1975, Siemens developed a prototype, and, in 1979, a single high-speed x-ray tube (Opti 110/12/50 HSG) that rotates 30° in its protective housing between two exposures, thus making possible stereo magnification serial angiography—the Stereolix system [5]. For x-ray magnification (factor 2.0) the stereo shift is 25 mm, which allows stereoscopy with only one tube (figs. 1 and 2) and up to two pictures/sec in serial operation (maximum, 20 pictures). Using the center focal spot position it is possible to use the conventional method of examination without restriction (fig. 3). The angiograms can be viewed simply as magnified images for conventional use, but when further detail is required, a pair of radiographs made consecutively may be reviewed to yield a three-dimensional display of vascular anatomy. The examination of stereoscopic images requires a stereoscopic viewer.

Discussion

In our opinion the advantage of this x-ray tube development lies in the fact that it can be used both for normal serial angiography and also for stereo magnification. Its easy versatility has been confirmed in the daily use of the apparatus (financed by the Deutsche Forschungsgemeinschaft) during the past 2 years. Early results have already been reported [6–8]. Our initial use of stereo magnification has been limited primarily to two areas: spinal angiography and intracranial aneurysm/arteriovenous malformation.

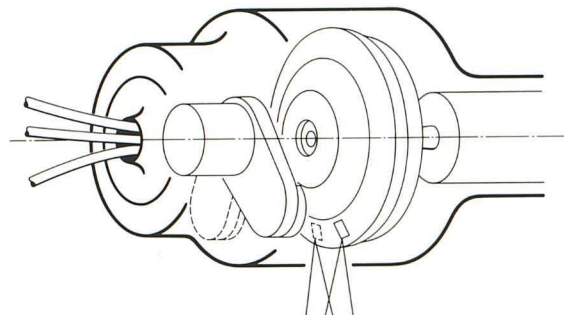


Fig. 1.—Stereolix tube rotates $\pm 15^\circ$ about longitudinal axis within housing.

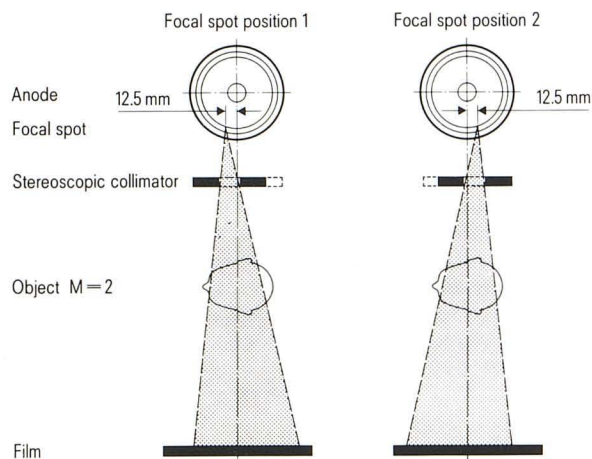


Fig. 2.—Stereoscopic operation. By rotating Stereolix tube, focal spot is shifted 25 mm (± 12.5 mm) to produce two images. Stereoscopic collimator is automatically matched to position of focal spot. M = magnification factor.

At this point we would like to report on our experiences with the technique in spinal angiography.

The collating of the individual veins and their exact location frequently causes difficulty in spinal phlebography, especially for persons with little experience in the technique. Angiotomography has been recommended for the differentiation of these veins [9]. However, this requires multiple injections and greater quantities of contrast medium. Stereo magnification techniques offer not only the advantage of $2\times$ magnification but also the benefit of stereo-

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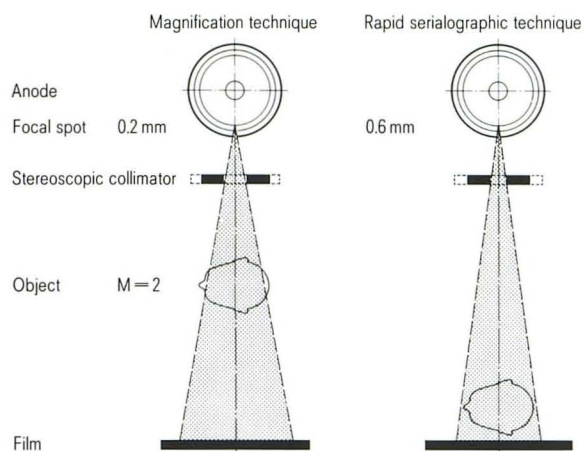


Fig. 3.—Mono operation. By pressing button, focal spot is moved to center position for conventional magnification and rapid serial radiography. M = magnification factor.

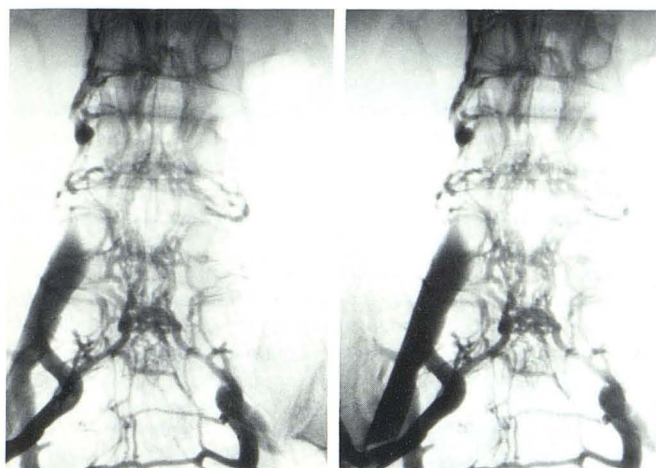


Fig. 4.—Pair of stereoscopic images. Spinal phlebographic examination (normal finding).

stereoscopic viewing, leading to a more exact localization of the veins (fig. 4), particularly in the spinal region where the volumetric content of spinal canal or spine is relatively small.

Our experience to date has confirmed that in spinal arteriography there is also an improved collating of the arterial supply, for example in the localization of arteriovenous angiomas (intra- or extramedullary) as well as venous drainage (fig. 5). The preparation of photographic subtraction films, obligatory in normal serial angiography, is unnecessary for stereo magnification (and would in fact create problems because of the lack of bony reference landmarks) [10]. Even the observer who lacks the equipment to view the stereoscopic images three-dimensionally obtains more information from two stereoscopic views than from conventional angiograms.

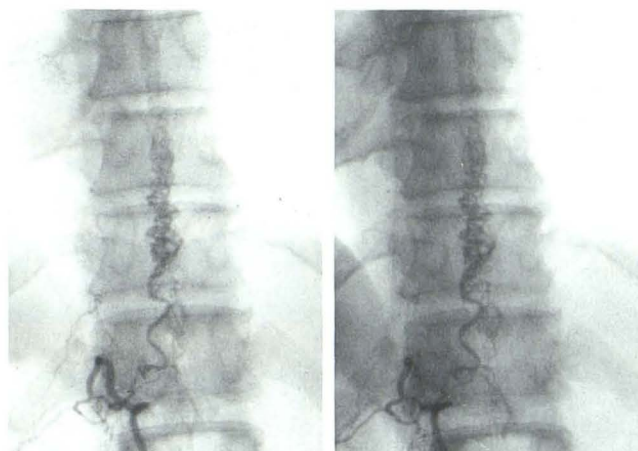


Fig. 5.—Pair of stereoscopic images. Spinal angioma in thoracolumbar region.

Today this method is routinely used in all spinal angiographies in our department.

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