Sizing rings: a simple technique for measuring intracranial lesions.

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AJNR Am J Neuroradiol 1995, 16 (7) 1449-1451
http://www.ajnr.org/content/16/7/1449.citation

Sizing Rings: A Simple Technique for Measuring Intracranial Lesions

Joseph A. Horton

But what shall we do for a ring?
"The Owl and the Pussycat," Edward Lear

Summary: This simple technique for the measurement of intracranial structures and lesions from radiographs makes use of rings of known size placed on the outside of the head before radiography.

Index terms: Radiography, technique; Head, measurements

There is now a need to measure accurately the sizes of intracranial lesions, particularly arteriovenous malformations (AVMs) and aneurysms. Until recently, this was not necessary, because the treatment options available for these lesions were limited to open surgery or nothing. Aneurysm size, for example, was relatively unimportant; what was important was only the issue of its location, whether it had a clippable neck, and whether there was vasospasm. Recent dramatic improvements in endovascular and stereotactic therapies have placed increasingly severe demands on accurate measurements from external references. The first use of this sort of measurement was for pelvimetry. To be useful, the sizes of bony and fetal structures must be corrected for their relationships to the x-ray beam geometry.

For cranial work, these measurements previously have been made by placing objects of known size on the surface of the head and taking radiographs. Typically, only one marker is used. When this is done, it is impossible to be accurate when correcting for magnification, because magnification is not constant within the head. By knowing where in the head a lesion to be measured is and by using structures of known size on opposite sides of the head, it is possible to correct for the changing geometric magnification that is intrinsic to radiographs.

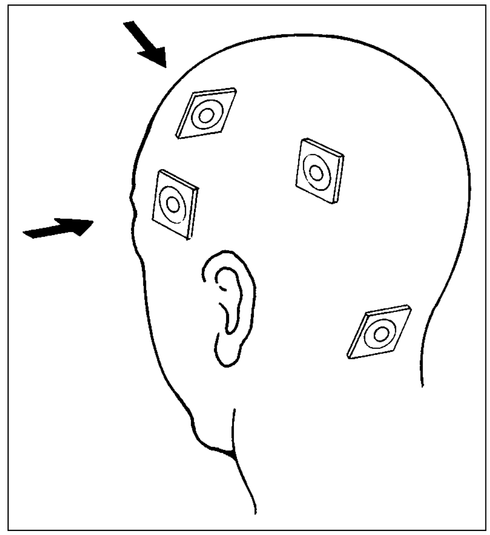

Fig 1. Positions of rings on head. *Black arrows* signify directions of central beams.

For the past several years, we have used a simple system consisting of two pairs of disks. We place one disk on each side of the head, one in front, and one in back (Fig 1). Each disk (Fig 2) has a 1- and 2-cm concentric circular groove inscribed; each groove contains a radioopaque material. Although it is not necessary for there to be two rings, the pair is easier to see than a single ring. We initially used (cleaned) platinum ends scavenged from used Target guide wires. Since then, these sizing rings (Vascutech, Andover, Mass) have been made by painting radioopaque ink onto medical grade tape. The tape then is mounted onto clear Lucite squares to make the structure rigid. This rigidity is necessary to prevent the rings from buckling; as

Received February 24, 1994; accepted after revision October 25.

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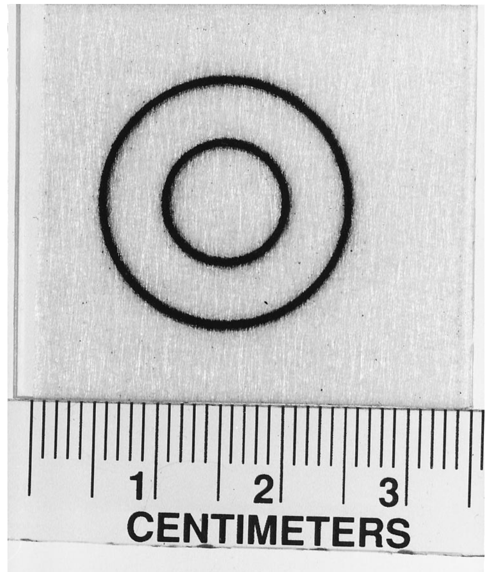
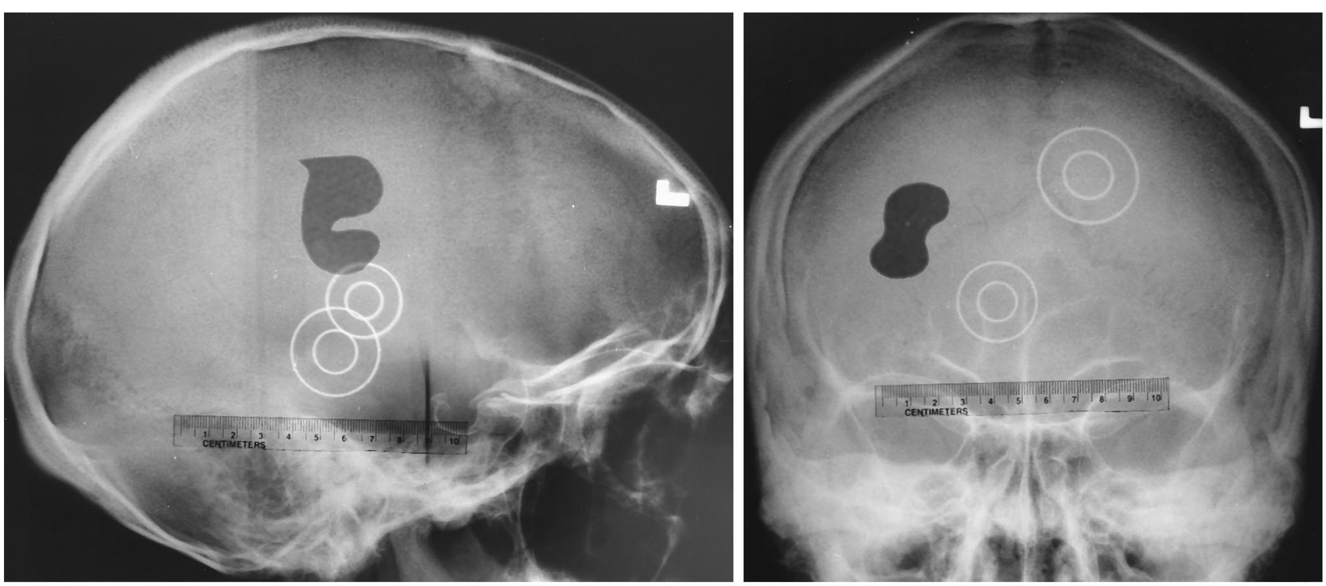
Fig 2. Sizing ring. The inner circle is 1 cm in diameter, the outer circle 2 cm. Rings are painted with radioopaque ink for opacity.



long as they remain round, they cannot distort and change size.

The measurement technique is straightforward (Fig 3). An angiogram is done with the rings in place. From the anteroposterior view, the relative weighting of the magnifications determined by the two side rings is calculated. Similarly, the lateral view determines the relative weighting of the front and back rings. Interpolation provides the correct magnification.

Although there still is some uncertainty (because the lesion itself usually is not flat), this has given us sufficiently accurate measurement to allow us to make decisions about various



A **B**

Fig 3. Simulated lesion. The lesion is midway between the front and back of the head (*A*, lateral) and halfway between the right outer table and the midline (*B*, anteroposterior). X-rays enter from the right. The 1-cm rings on the anteroposterior view measure 1.4 and 1.7 cm, respectively. This gives an average magnification of 1.55. Because the lesion is halfway between the two markers, its magnification is 1.55. The 1-cm rings on the lateral view measure 1.4 and 1.6 cm. Because the lesion is only one fourth the way from the side of the head with the most magnification, the lesion magnification on the lateral view is $[(3 \times 1.6) + 1.4]/4 = 1.55$ also.

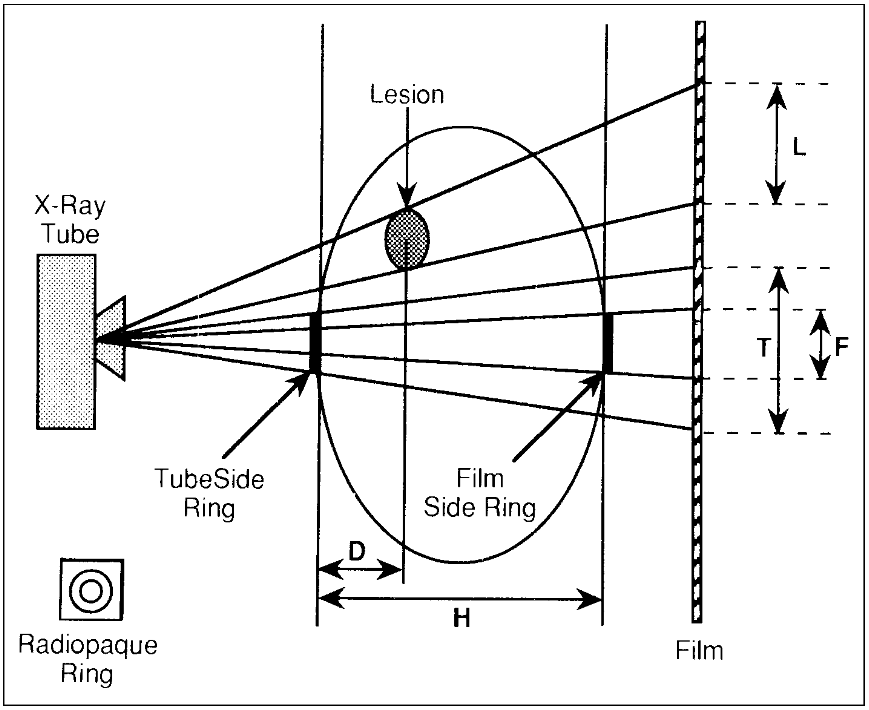


Fig 4. Diagram of measurements. See "Appendix" for explanation.

treatments. This is exemplified in radiosurgery for AVMs, because lesion volume correlates highly (though inversely) with likelihood of obliteration (1).

Appendix

How to Do It: The Theory and the Formula

Using the 1 cm circles only, measure

- T (in cm) = magnification factor at the tube side of the head;
- F (in cm) = magnification factor at the film side of the head;
- L (in cm) = measured size of lesion uncorrected for magnification;
- D = distance from tube side of head to level of lesion;
- H = width of head (Figs 3 and 4).

All measurements are made from x-rays. T, F, and L are made from the radiograph being used; D and H are obtained from the orthogonal radiograph. Thus, when the measurement is being made on the lateral view, measure T, F, and L from the lateral view, D and H from the anteroposterior view. When measuring from the anteroposterior view, do the opposite.

The magnification factor at the level of the lesion is

$$M = \left(\frac{D}{H}\right) \times F + \left(1 - \frac{D}{H}\right) \times T$$

which is always greater than 1. We want the *actual* size, S, of the lesion.

Because there is magnification of M, we know that the measured size, L, is

$$L = M \times S .$$

Because we just calculated M, and measured L, we can calculate the actual size by

$$S = \frac{L}{M} .$$

Reference

1. Lunsford LD, et al. Stereotactic radiosurgery for arteriovenous malformations of the brain. *J Neurosurg* 1991;512–524