

A PELVIC ANATOMICAL COORDINATE SYSTEM

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At the second annual meeting of the Ad Hoc Committee the guidelines were proposed for the establishment of anthropometric landmarks and of anatomically-based body-fixed coordinate systems for various body segments (1). In particular, the head and the first thoracic vertebral coordinate systems were illustrated. As a continuation of this effort, consideration was given to the pelvic anatomical coordinate system.

In its second report, the Ad Hoc Committee to Establish Guidelines for Comparison of Human and Human Analog Biomechanical Data, a pelvic coordinate system was proposed as follows:

A plane can be defined by the right and left anterior superior iliac spine and the mid-point of the upper edge of the pubic symphysis. The origin is located in this plane at the mid-point of the line joining the right and left anterior superior iliac spine. The first axis (+X) is normal to the plane of the triangle which is closest to the anterior direction. The second axis (+Y) is to the left along the line connecting the anterior superior iliac spines. The third axis (+Z) is at right angles to the other two which is closest to the superior direction.

This coordinate system is shown in Figure 1 and the landmarks are identified by black circular rings in the x-ray shown in Figure 2. In a normal pelvis the Z-axis will coincide with a line joining the mid-point of the upper edge of the pubic symphysis and the origin. The advantage of this coordinate system is twofold. First of all, the proposed landmarks are easy to locate

either by palpation or by x-ray. Secondly, a coordinate system can be defined for either the seated or standing position. Although this coordinate system was not used directly, the selected reference points have been palpated to define pelvic orientation of human volunteer subjects. (2).

This coordinate system has also been used successfully on cadavers. Figure 2 shows an anterior-posterior view of the lower torso of one of the cadavers. It is also identified in Figure 3, which is a lateral view. Figure 4 shows a superior-inferior view. The circles in the figures identify the landmarks necessary for the construction of the coordinate system.

It is important to point out that x-ray anthropometry is subject to serious parallax errors. An off-center beam can cause an inaccuracy in the location of the origin. This is demonstrated in Figures 5 and 6 which show x-rays of a circular cylindrical tube for a centered and an off-center beam respectively. The potential for error is obvious. Furthermore, Figure 7 shows the effect of misalignment of the beam with respect to the coordinate plane. This x-ray was taken with an oblique x-ray beam.

The use of x-ray anthropometry in the pelvic area may not be feasible when human volunteers are involved, particularly female volunteers. Thus, the ability to determine the landmarks by palpation and the availability of equipment to locate them in three-dimensional space (2) are important aspects that should be considered when pelvic anatomical coordinate systems are to be set up.

In conclusion, the proposed guidelines for the establishment of a pelvic anatomical coordinate system were successfully tested on cadaveric subjects. Some of the pitfalls in the determination of the origin of the coordinate system were discussed.

REFERENCES

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2. Nyquist, G. W. and Murton, C. J.: Static Bending Response of the Human Lower Torso. Proceedings of the 19th Stapp Car Crash Conference, Society of Automotive Engineering, Inc., San Diego, California, November, 1975.

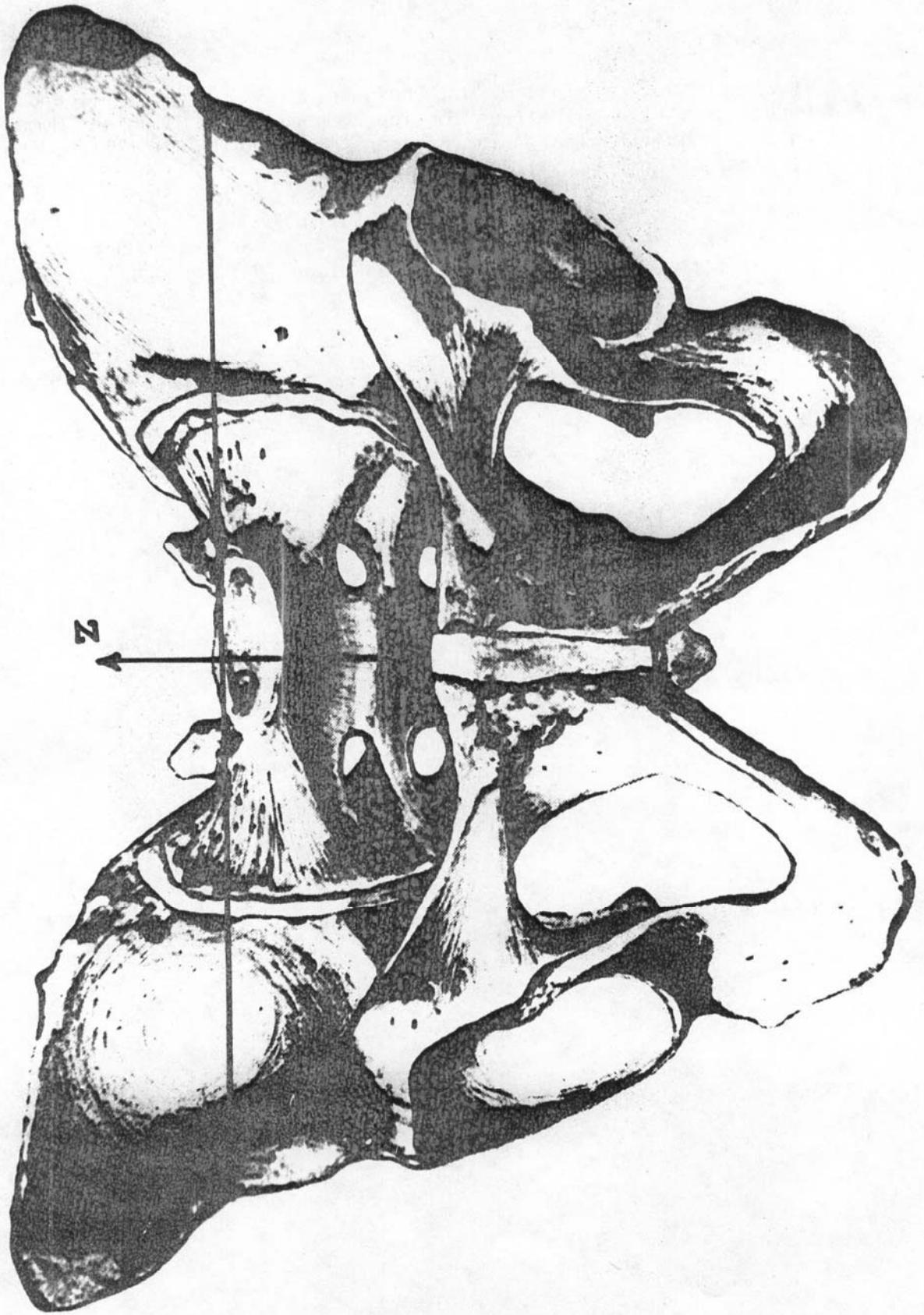


Fig. 1 A Pelvic Coordinate System

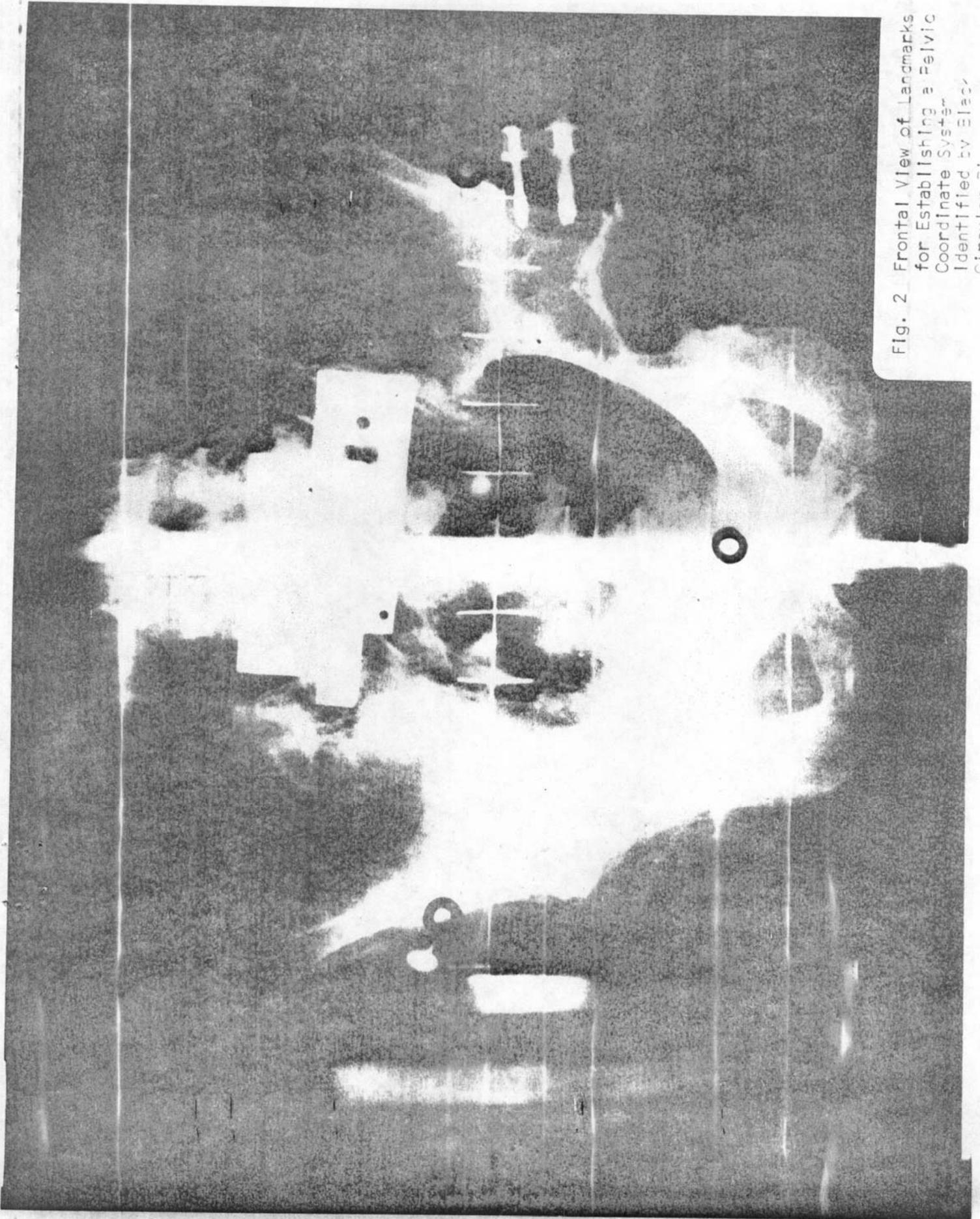


Fig. 2 Frontal View of Landmarks
for Establishing a Pelvic
Coordinate System
Identified by Black
Circular Rings

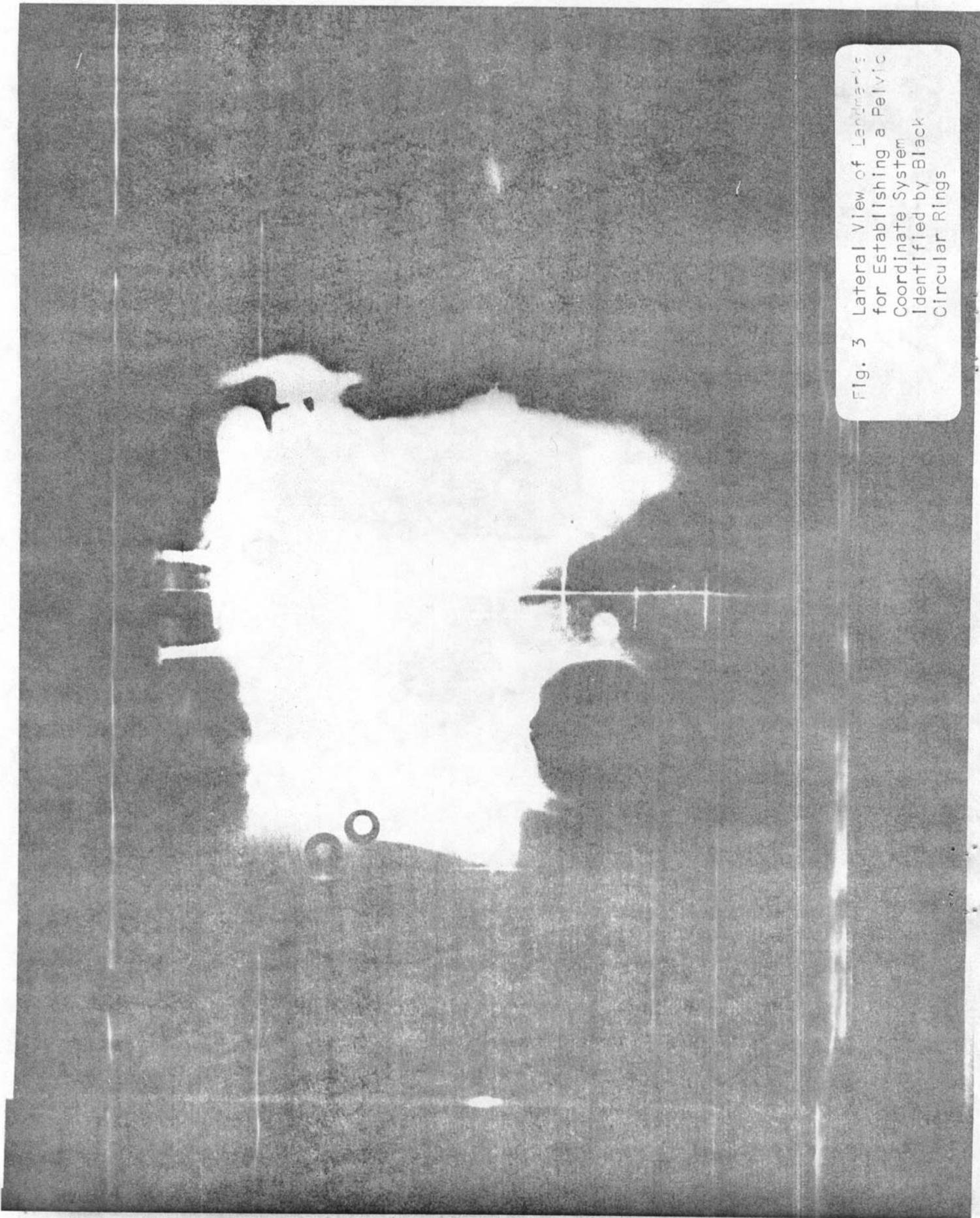


Fig. 3 Lateral View of Landmarks
for Establishing a Pelvic
Coordinate System
Identified by Black
Circular Rings

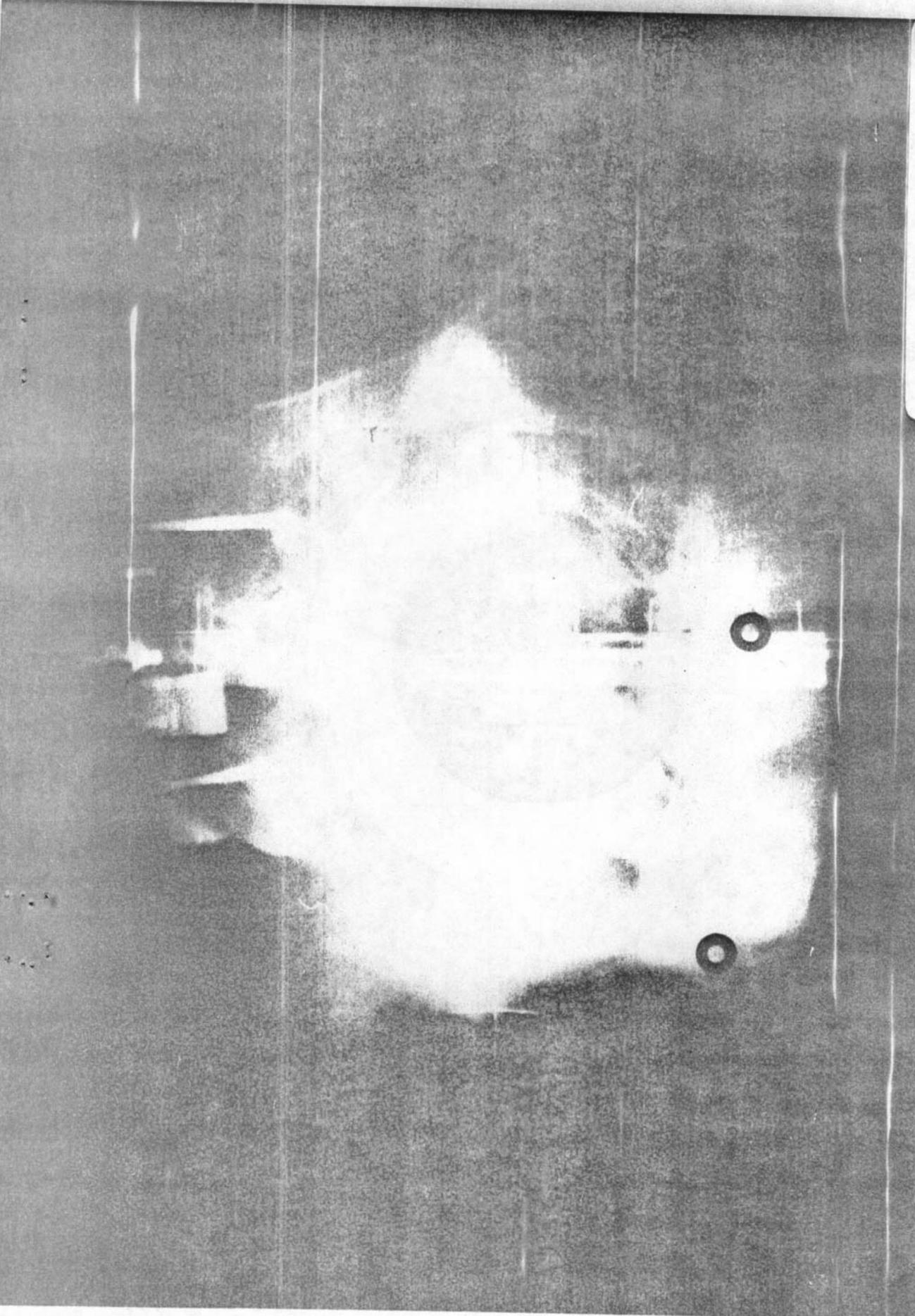


Fig. 4 Top View of Landmarks
for Establishing a Pelvic
Coordinate System
Identified by Black
Circular Rings

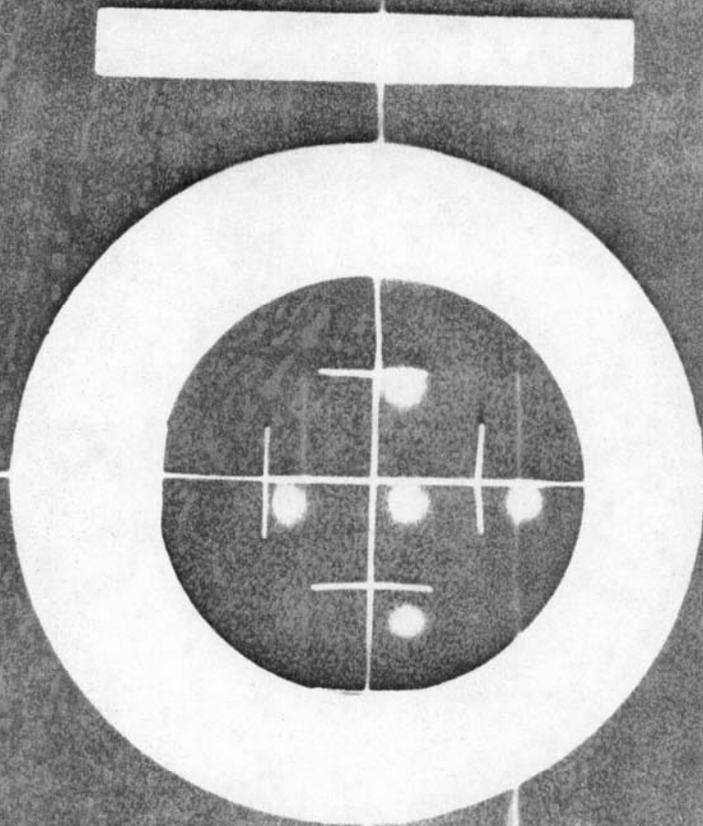


Fig. 5 X-ray of a Cylindrical Tube
- X-ray Beam was Centered

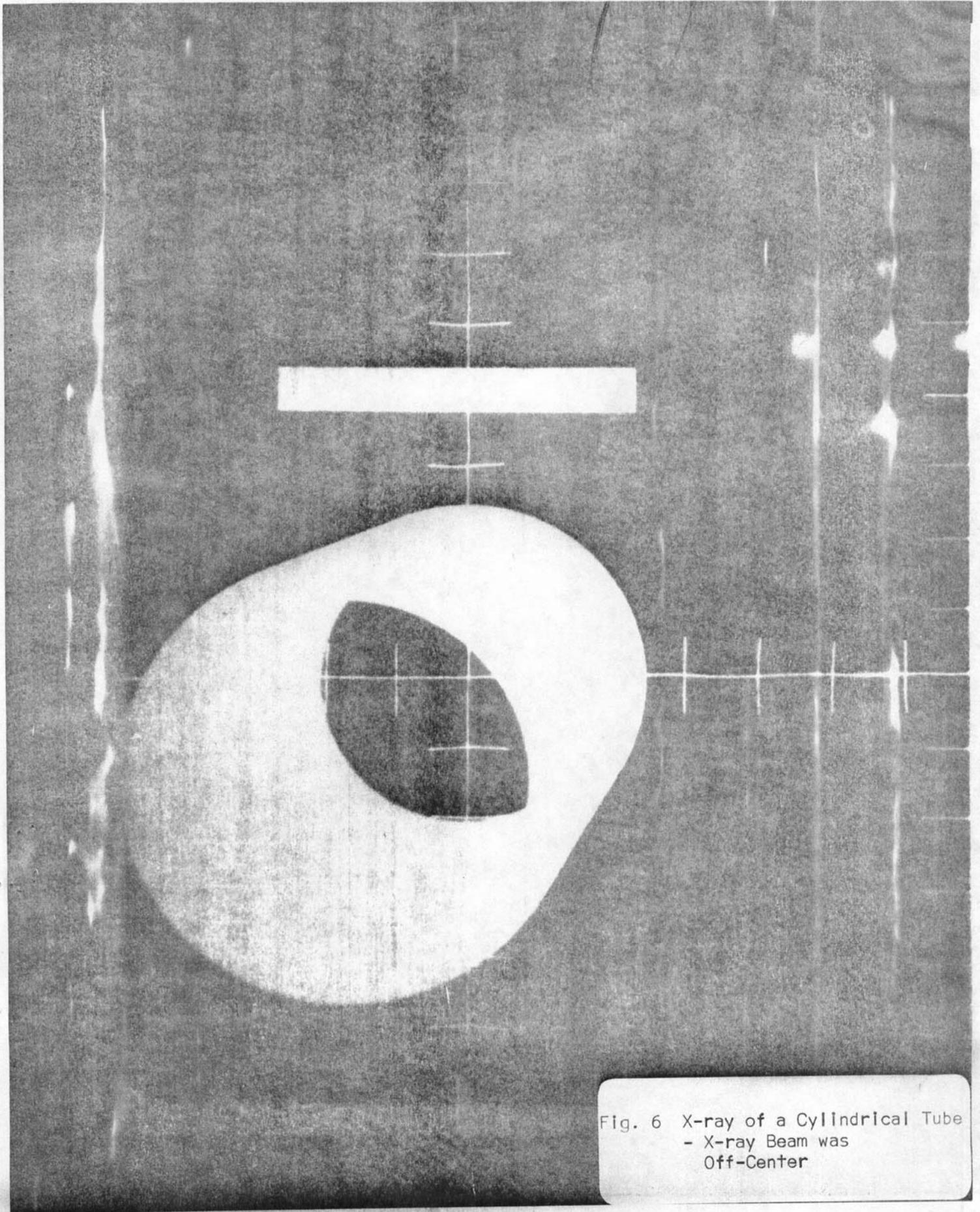


Fig. 6 X-ray of a Cylindrical Tube
- X-ray Beam was
Off-Center

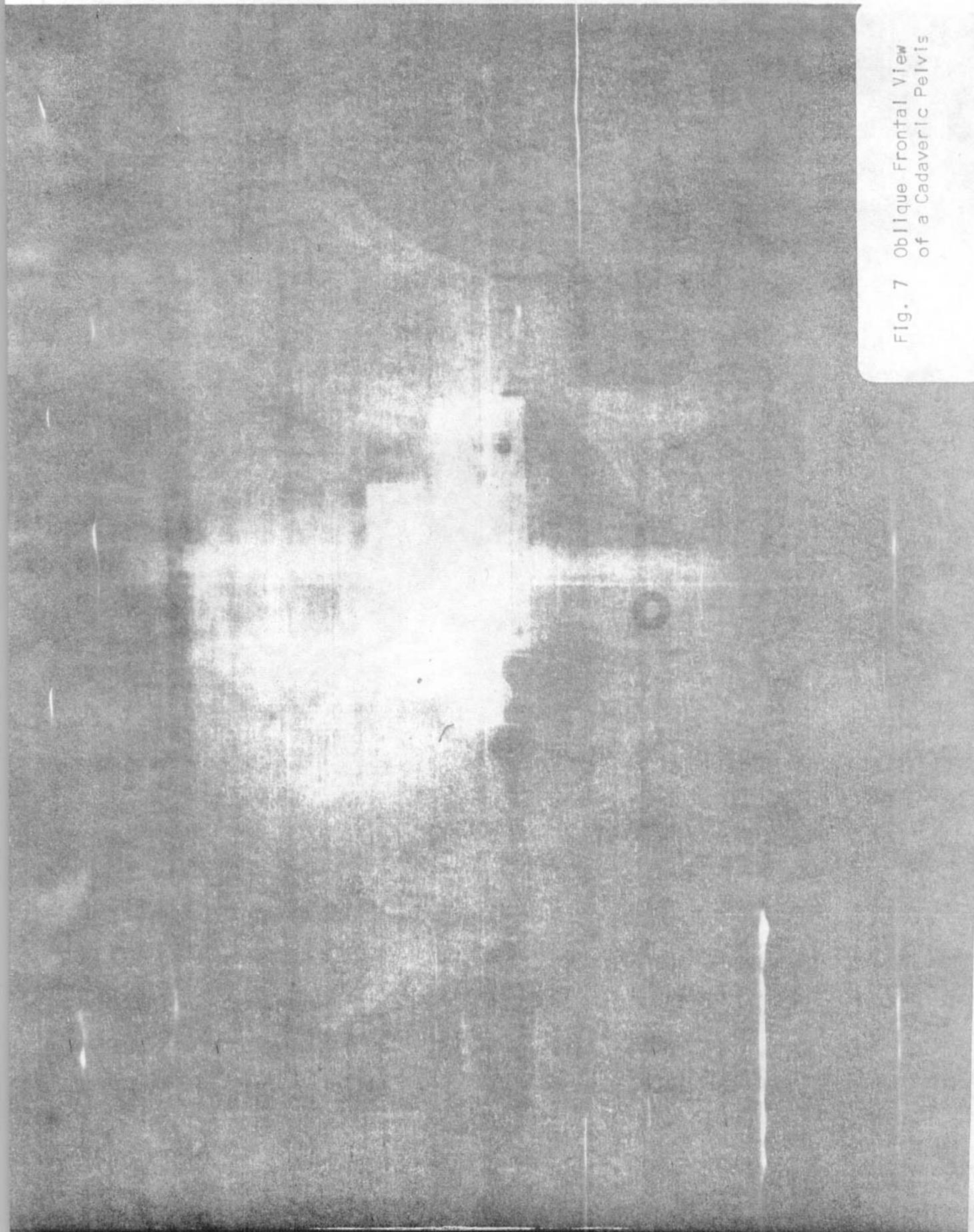


Fig. 7 Oblique Frontal View
of a Cadaveric Pelvis