

# Special projections

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Selective coronary arteriography by the Sones technique was started at the Toronto General Hospital in 1960. A then “standard” x-ray system with the image intensifier above and the x-ray tube mounted below the table was used, which essentially limits projections to the transverse plane. With growing experience, it became clear that diagnostic accuracy was being compromised by the limitations posed by such an x-ray system. The transverse plane often foreshortened the proximal left anterior descending and circumflex arteries in the left anterior oblique view and the distal right coronary artery in the right anterior oblique view. Overlap, especially when a narrow divergent angle was present, obscured the origin of branches of the left anterior descending artery in the right anterior oblique view and in the distal right coronary artery and the origin of the posterior ventricular branch in the left anterior oblique view. Foreshortening and overlap were further complicated by asymmetry of the lesion, i.e., eccentric, crescentic, or even multiluminal obstruction.

In 1973 we installed a U-arm with a table rotating horizontally through the isocentric cardiac axis, the first Cardoskop-U, built to our design aspirations by Siemens. Thus, cranial and caudal angles could be easily added to the transverse plane,

quickly confirming that routine use of these projections increased diagnostic accuracy in a substantial number of studies.

Analysis of 100 consecutive studies highlighted the magnitude of the problem in showing that an improved diagnosis was obtained in 54% of the studies. In 33.5%, the lesions had to be upgraded and in 20.5%, lesions were unmasked that were not evident in the transverse plane. In fact, of 12 studies judged normal in the transverse plane, four had significant lesions: three in the proximal left anterior descending and first diagonal region and the fourth at the origin of the right (acute) marginal branch.

An analysis of the problem areas showed the following incidence:

#### Left coronary artery

- Proximal left anterior descending, 32%
- Origin of first diagonal, 32%
- Proximal left (obtuse) marginal, 8%
- Proximal circumflex, 8%

#### Right coronary artery

- Origin of right marginal, 15%
- Distal right and origin of posterior ventricular branch, 10%
- Proximal right, 4%

In some patients visualization of more than one area was improved.

The easiest way to obtain these cranial/caudal angles is with a U- or C-arm, either with all the movements in the arm or some movements in the arm and some in the table. The exact choice of manufacturer's equipment is clearly governed by individual preferences based on performance, finances, and adequate servicing.

The increasing use of x-ray systems rotating freely about the patient has caused some concern regarding radia-

tion hazards to the operator. These systems make the operator more vulnerable in the left anterior oblique view, as compared to the right anterior oblique view when the image intensifier is mounted in the fixed position above the x-ray tube below the table. Screening methods introduced to reduce such radiation usually interfere significantly with the maneuverability of the U-arm systems.

Usually five projections of the left and three to four of the right coronary arteries including angled views provide sufficient diagnostic data, although in difficult cases or when pacing or ergonovine studies are done the numbers may increase.

#### Left coronary artery

- 50° Left anterior oblique
- 50° Left anterior oblique + 30° cranial
- Left lateral or 70° right posterior oblique
- 30° Right anterior oblique
- 60° Right anterior oblique + 30° caudal

#### Right coronary artery

- 50° Left anterior oblique
- 30° Left anterior oblique + 30° cranial
- 30° Right anterior oblique ± 15° caudal
- Posteroanterior + 30° cranial

In summary, there are considerable data to suggest that selective coronary arteriography without routine cranial/caudal projections provides incomplete and inaccurate diagnosis in at least half of the patients studied. These special angles can be most easily obtained by some form of U- or C-arm system. Care should be taken to limit the coronary injections to a minimum but diagnostically adequate number to contain radiation to the operator.