Fixed Flexion Knee Radiography and the Synaflexer™ Frame

The Synaflexer x-ray positioning frame[1] allows standardized positioning and a check of the geometry used during fixed flexion knee radiography. It contains two parallel rows of metal beads of known separations encased in a plexiglass frame of known dimensions. On the radiographs, these metal beads appear in two vertical lines (see figure 1).

Figure 1. An example MOST fixed flexion radiograph showing the right knee (on the left hand side of the image), and left knee (on the right hand side of the image), and the Synaflexer Frame, with two parallel rows of metal beads. In each row, the vertical spacing between the beads is 1", but the row of beads on the left hand side of the image is further away from the detector than the row of beads on the right hand side of the image (see text for more details).

In an optimally acquired MOST fixed flexion radiograph, these lines will be almost exactly parallel, and the spacing between the beads for the line on the left hand side of the image will be slightly greater than for the line on the right hand side of the image. Within each line of metal beads, the beads will have almost exactly equal spacings. The row of beads with the largest spacing is offset 1 ¾" (44.5mm) posteriorly from the point on which the patella presses against the frame during the exposure, and is hence in approximately the same coronal plane as the center of the tibio-femoral joint. The other row of beads is offset ¼" posteriorly from the point at which the patella presses against the frame. The actual vertical spacing of the beads is 1" (25.4mm), so by measuring the inter-bead spacing on the row of beads on the left side of the image, the conversion from image pixels to true distance at the joint line can be performed.

The protocol for acquiring the fixed flexion radiographs requires that the x-ray beam makes an angle of 5, 10 or 15 degrees downwards (cranio-caudally) at the level of the joint line. Each x-ray is labeled with it's nominal beam angle, but the metal beads on the Synaflexer frame can be used to estimate the true angle. To do this, the difference in relative heights of two matched beads from the Synaflexer Frame can be used to estimate the beam angle for an image. Figure 2 shows an example of the metal beads and the formula used to estimate the angle.

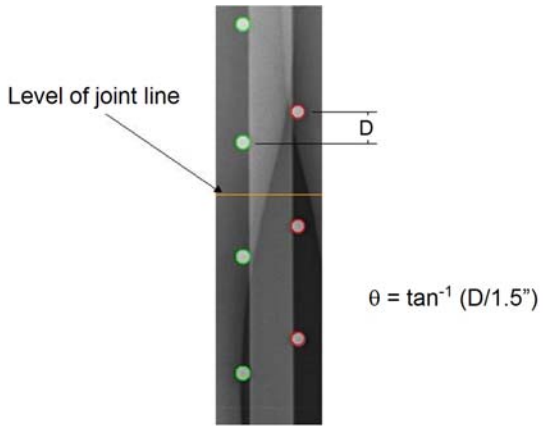

Figure 2. Formula for calculating the approximate beam angle (θ) at the level of the joint line from the vertical spacing (D – in inches) between 2 matching metal beads on the Synaflexer frame.

[1] See Kothari M, Guermazi A, von Ingersleben G, et al. Fixed-flexion radiography of the knee provides reproducible joint space width measurements in osteoarthritis. Eur Radiol. 2004 Sep;14(9):1568-73. Epub 2004 May 19. (http://www.ncbi.nlm.nih.gov/pubmed/15150666?ordinalpos=6&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_DefaultReportPanel.Pubmed_RVDocSum)

Also see CCBR-Synarc Synaflexer™ x-ray positioning frame information at http://ccbrsynarc.com/services/osteoarthritis/radiography.html