Enhancing C-Arm Knowledge and Finding Perfect Circles

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The purpose of this educational experiment was to enhance the skills and knowledge of radiography students in a simulated surgical scenario. The students learned about C-arm projection, including how to:

- collimate and rotate the image or collimation
- increase or decrease magnification
- move the image intensifier closer to or further from the object being imaged
- obtain various images and compare them
- obtain perfect circles using a metal rod with holes in it

The students then used image critique to figure out how to adjust the C-arm to achieve the perfect circles. This experiment resulted in hands-on learning and guided teaching methods to enhance the knowledge of surgery and the C-arm for first-year radiography students. Finding ways to educate students on the C-arm functions before they begin their clinical experience could give them a good start on succeeding in the clinical environment and improving those skills more quickly.

Materials and Methods

To conduct this experiment, the students need a functional C-arm, a proximal hip or pelvis phantom, and a distal femur or knee phantom. Other materials include a metal rod with small holes, and lead aprons or shielding for radiation protection. The metal rod used for this experiment was a steel rebar construction stake. This stake simulates an intramedullary nail.

Students worked together in groups of 5 to learn the functions of a C-arm. The experiment included several steps for students to perform. The goal was for them to experiment with common functions that technologists use when they operate a C-arm.

Step 1

Students obtained a posteroanterior (PA) image of the knee using a single exposure of the knee phantom in normal fluoroscopy mode. Then they saved and moved the image to the next workstation screen. This step allowed students to understand a few different concepts. First, the tube of the C-arm is underneath the patient as the phantom is supine, which helps them understand why it is a PA knee projection and not anteroposterior. The students learn how to save an image, how to move an image to another workstation screen for comparison, and how to use the image hold feature.

Next, the students were required to increase magnification and obtained another image. Visual differences were noted between this new image and the previous normal fluoroscopy PA knee image. Students were given the opportunity to increase magnification further and note visual differences. Students also were told to observe the technique change each time they increased or decreased the magnification mode.

Step 2

Students returned the image mode to normal and obtained a PA image of the hip using the pelvis phantom. The rotate image function was used to straighten the image and decide how it should be oriented on the workstation screen. The next image the students obtained was a lateral hip. They had to be careful not to hit the phantom or the table while moving into the lateral position. This step also required the students to learn how to raise and lower the C-arm adequately to center the image. After the lateral hip image was achieved, the students then saved and moved the image to another workstation, collimated closely to the lateral hip, and reimaged the phantom (see **Figure 1**). This activity allowed them to learn how to collimate and rotate the collimation, as well as assess the visual differences between the images.

Step 3

In this step, the C-arm remained in the lateral position but centered to the distal femur. The students obtained a lateral distal femur radiograph, saved the image, and moved it to another workstation. The students then moved the image intensifier closer to the phantom and reimaged it to evaluate the visual difference on the image. Then they moved the image intensifier further away from the object and imaged the phantom again, noting the visual differences.

Step 4

The fourth step had the students simulate perfect circles. The instructor took the steel rebar construction stake and lined it up with the distal femur using a radiolucent sponge (see **Figure 2**). The students were required to obtain an image, critique the image, and

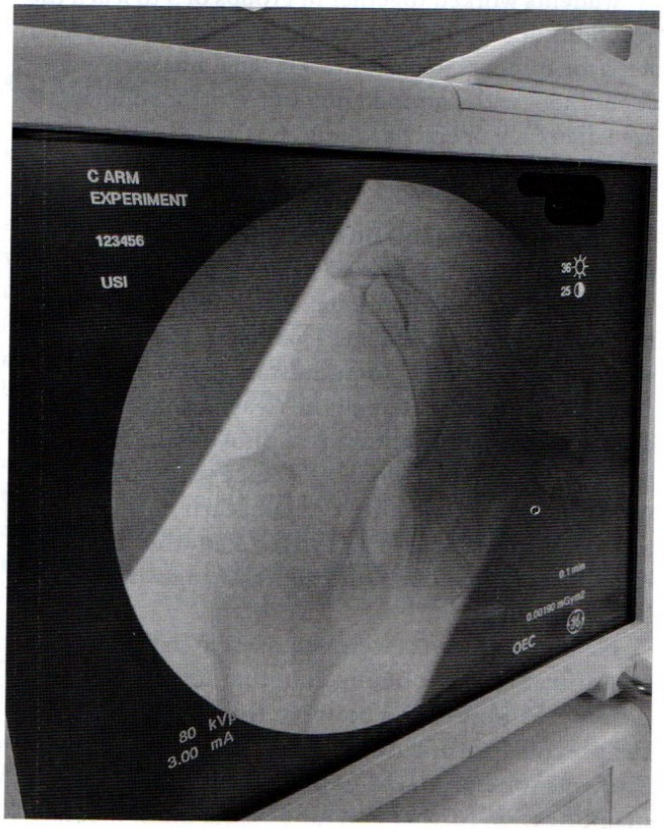

Figure 1. *Lateral image of hip phantom after collimation. Photograph courtesy of the author.*

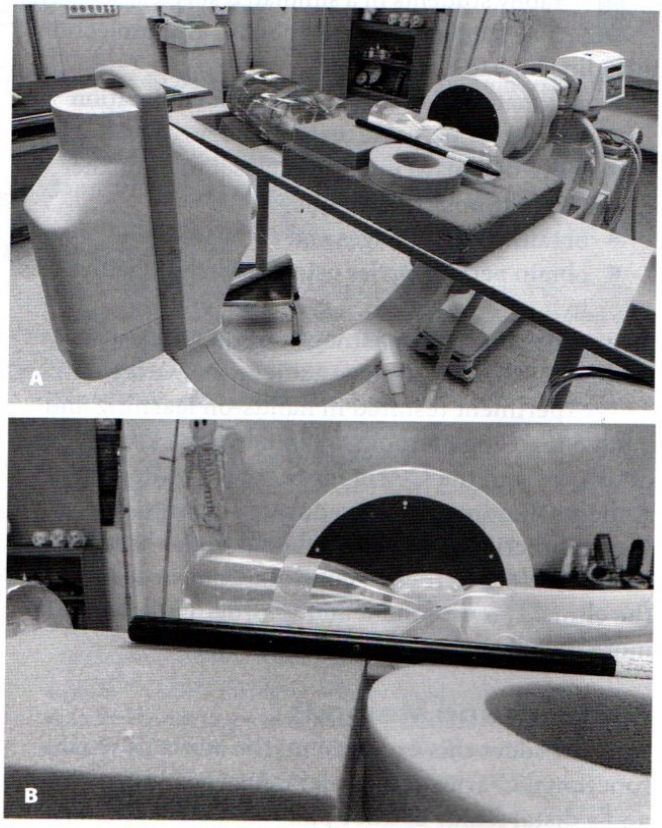

Figure 2. *A. Setup for perfect circles simulation. B. Steel rebar construction stake is lined up with the distal femur using a radiolucent sponge Photographs courtesy of the author.*

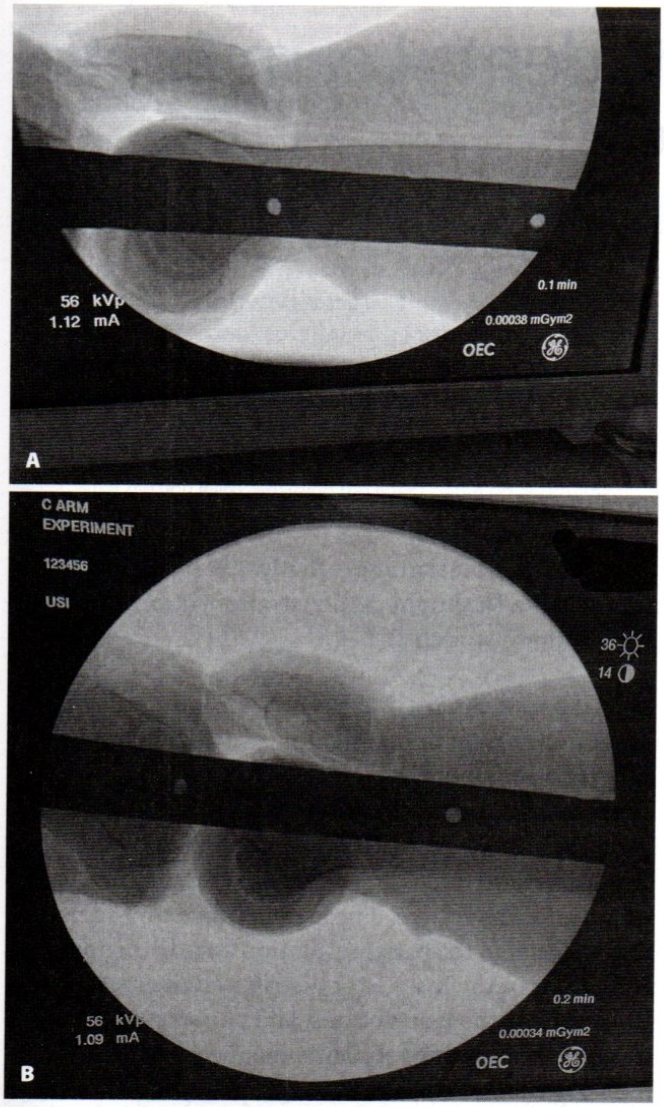

Figure 3. *Image of distal femur used for perfect circle critique. A. Image before critique and adjustment. B. Perfect circle after critique and adjustment. Photographs courtesy of the author.*

then brainstorm how they should adjust the C-arm to achieve the perfect circles (see **Figure 3**). This process allowed the instructor to explain why this projection is important for the surgeon and that distal locking screws would be used here.

Conclusion

Students' oral feedback and engagement throughout this experiment were extremely positive. The students enjoyed learning how to use the different locks and functions to achieve the desired image. They also enjoyed the guidance they received, the explanation of an intramedullary nail procedure, and the steps involved from the surgeon's and radiologic technologist's perspectives. The students attended a lecture on the C-arm, fluoroscopy, and image intensifiers the day before this experiment, so they were able to apply what they learned in the classroom to this experiment. This experience helped enhance their skills and confidence for the clinical environment.

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