

# THE WANDERING PROJECTILE: POOR X-RAY TECHNIQUE AND CRITICAL ERRORS

Justin Leavitt MD, Christopher Carballo MD, Caleb Mentzer DO†, Faran Bokhari MD‡, James R. Yon MD

Novant Health New Hanover Regional Medical Center – Wilmington, NC

## Introduction

When an unstable patient with penetrating thoracic injury arrives, the surgeon must sometimes make operative plans without the benefit of cross-sectional imaging. This is especially true for cardiac injury. Plain films are often used to localize missiles and guide clinical management. The surgeon depends on these images to accurately determine the path of the projectile or blade and plan the proper operative technique. Potential exists for wide variance in technique when obtaining portable x-rays. We hypothesize that poor technique can have significant impact on imaging outcomes.

## Methods

A commercially available solid anthropomorphic thorax phantom was modified using a radiopaque wire to delineate the anterior cardiac box, posterior box, and left ventricle (Fig. 1). Different “projectile” markers were then applied to the anterior and posterior model. A GE Revolution x-ray machine was used to project a series of anterior-posterior images onto a digital flat plate. A benchmark film was obtained at 0°, then the x-ray source was moved to -15°, -5°, 5°, and 15° serially in the x- and y- axes, keeping a distance of 40cm at all times. Two different sets of images were performed on two separate days with different radiographic technicians. The radiographic images compared against the reference image and the displacement of each marker was digitally measured at multiple reference points.

## Results

There was a direct correlation between degree of rotation and amount of marker displacement. Anterior markers were displaced more than posterior markers (Fig 2.). Multiple measurements were made for each point. All of these displacements were statistically significant ( $p < 0.0001$ ), and different from each other ( $p < 0.01$ ). Average displacement for markers in the anterior box was  $0.29\text{cm}/^\circ$ , and  $0.13\text{cm}/^\circ$  for the posterior box.

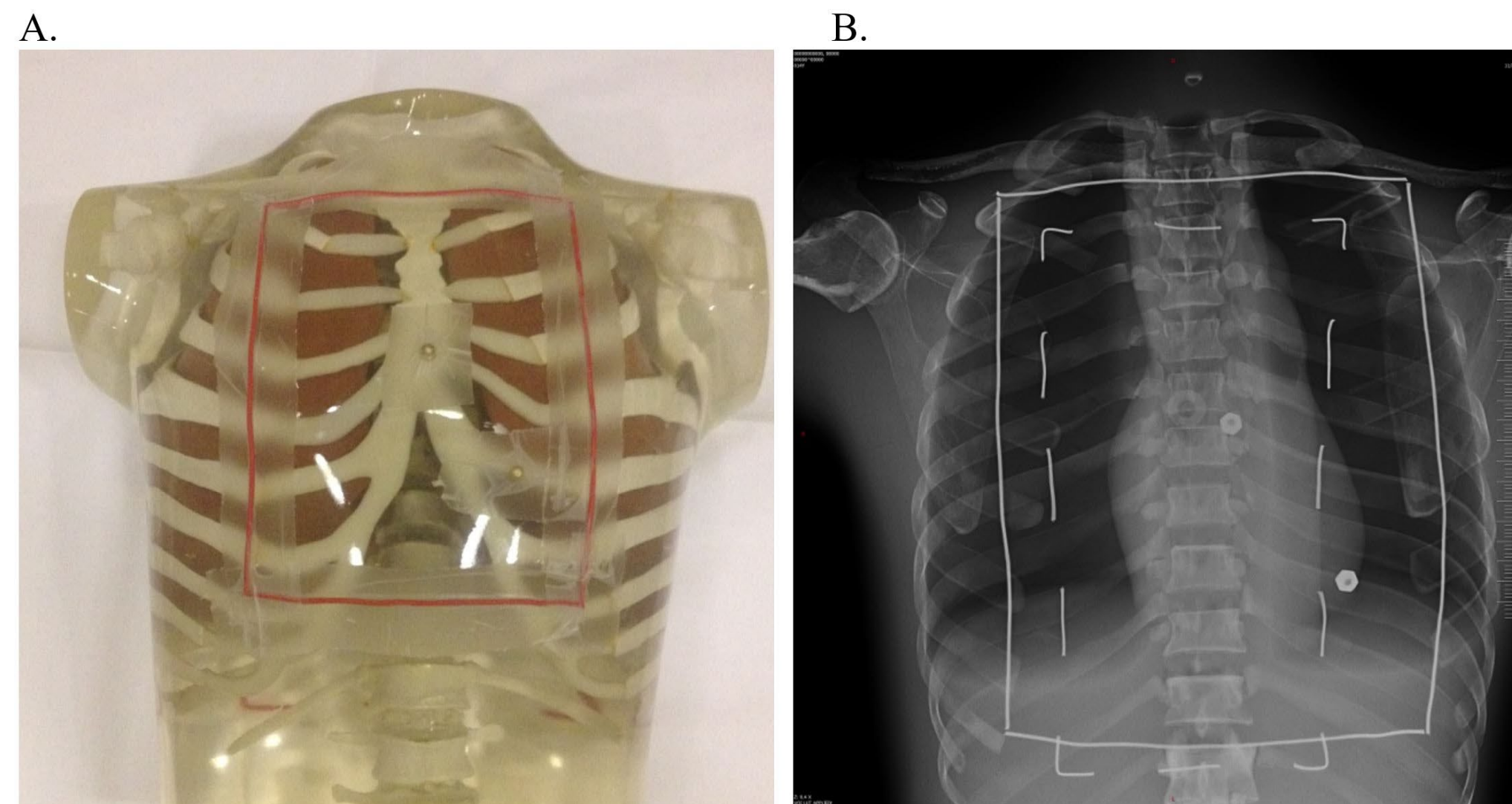


Figure 1. Thorax phantom (A), and digital x-ray result (B).

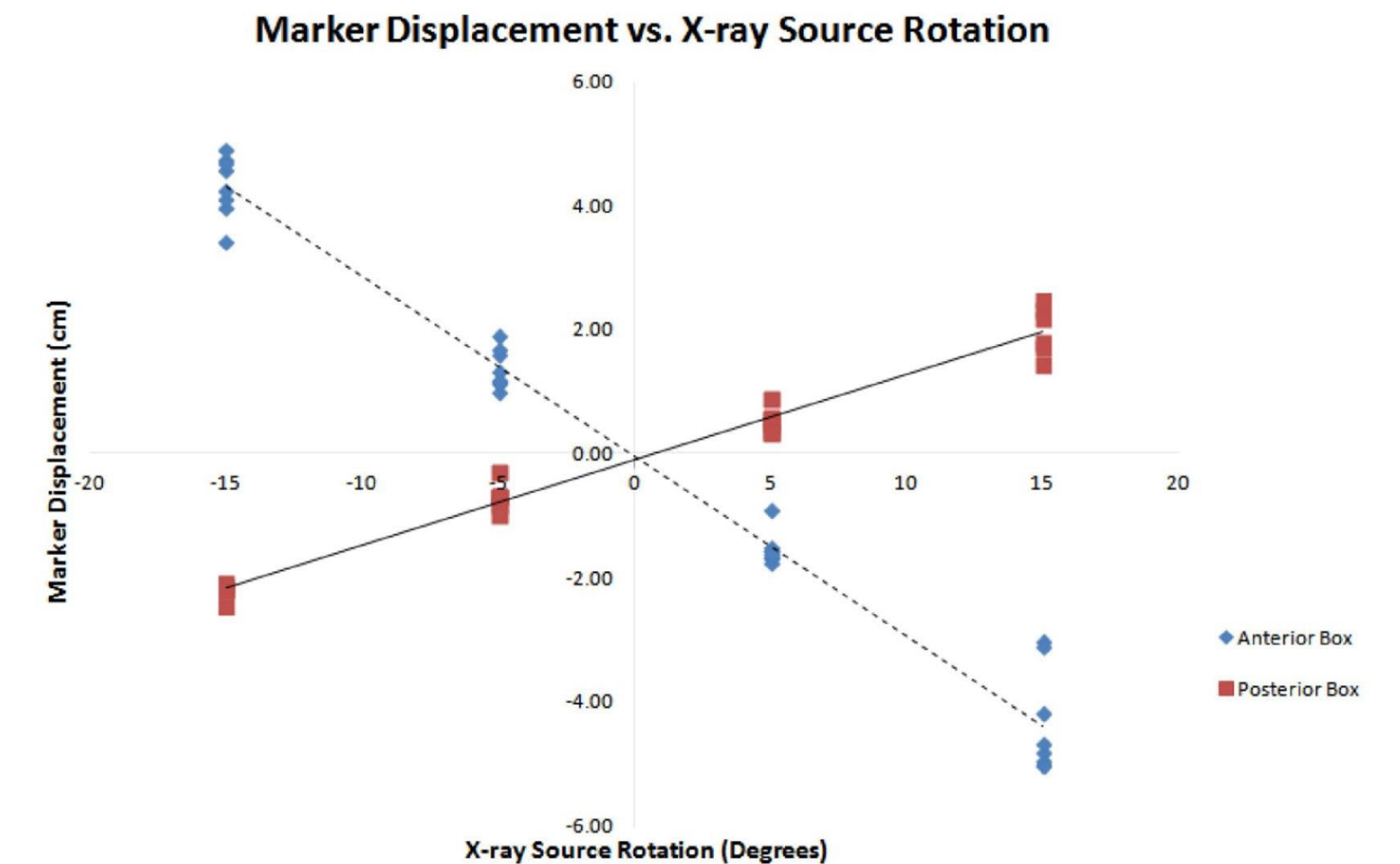


Figure 2. Marker displacement versus x-ray source rotation.

## Conclusion

Single anterior-posterior portable chest x-rays are not adequate to localize foreign bodies or guide clinical management. Minimal changes in angle during radiographic imaging can lead to significant error. Missiles located closest to the x-ray source demonstrate greatest displacement demonstrating that even a small amount of rotation can influence the radiographic results. This has direct implications in patient care as it can lead to erroneous assumptions about injury patterns and subsequent operative planning. Determining trajectory and the subsequent at-risk structures is crucial for the trauma surgeon as is identifying a technically adequate radiographic image.

For more information contact: Justin Leavitt MD, justin.leavitt@novanthealth.org

†Spartanburg Medical Center – Spartanburg, SC

‡John H. Stroger, Jr. Hospital of Cook County – Chicago, IL